Inteligência Artificial e Educação em Saúde

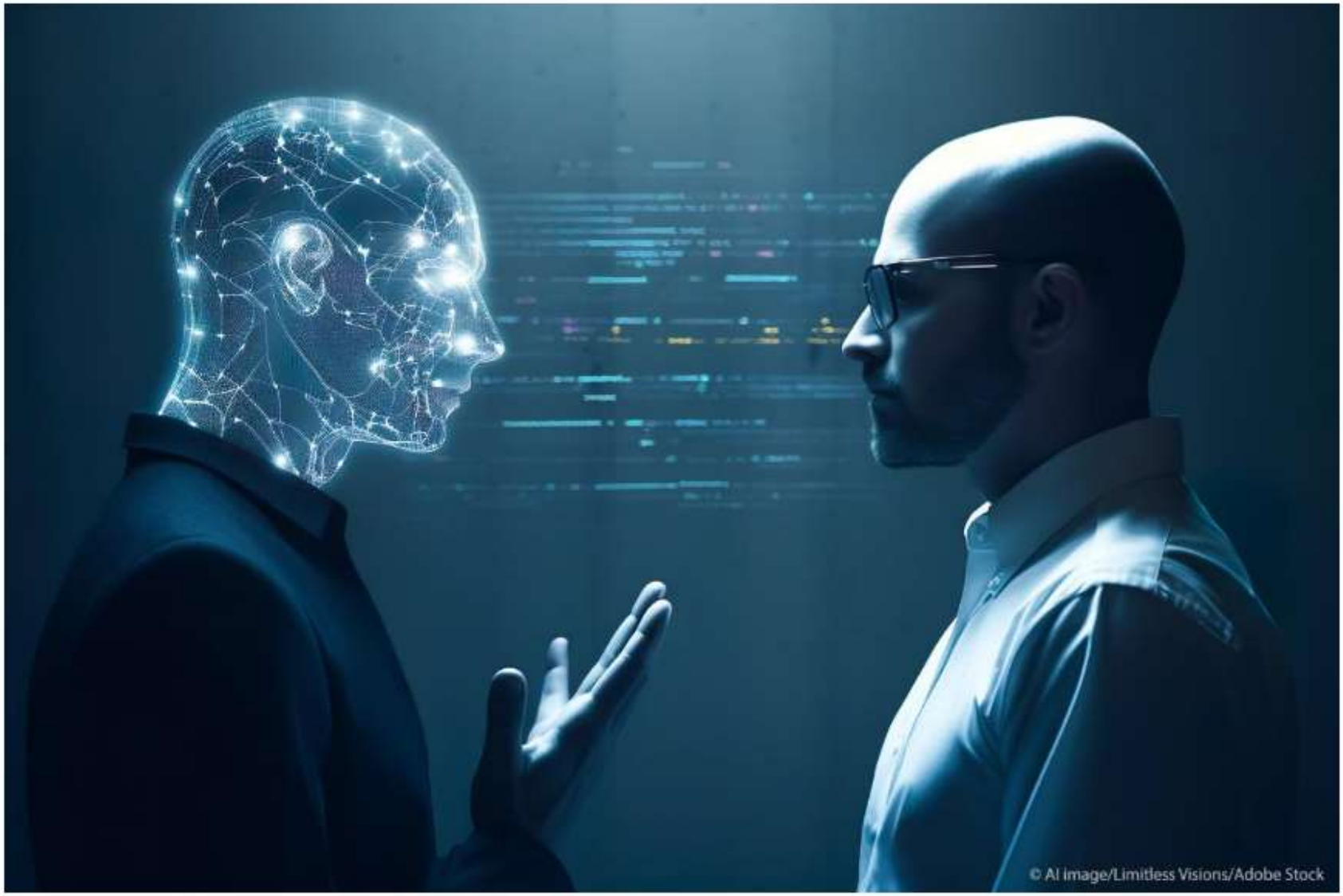
Vinícius M. P. Guirado, *MD, MSc, MBA*

In.Lab - InovaHC - HCFMUSP
Santa-IA - Santa Casa de São Paulo

Declaração

Não tenho conflito de interesse

Guirado et al., 2025



This illustration of artificial intelligence has in fact been generated by AI

EU, 2024

Guirado et al., 2025

Sumário

Desafios e Estratégias para o Setor Filantrópico

A Revolução da IA na Saúde

A Lacuna Educacional

Por Que se Preocupar?

Competências Essenciais para a Era da IA

Co-construção de soluções relevantes para o setor filantrópico

Case In.Lab - InovaHC - Hospital das Clínicas FMUSP

Guirado et al., 2025

Sumário

Desafios e Estratégias para o Setor Filantrópico

A Revolução da IA na Saúde

A Lacuna Educacional

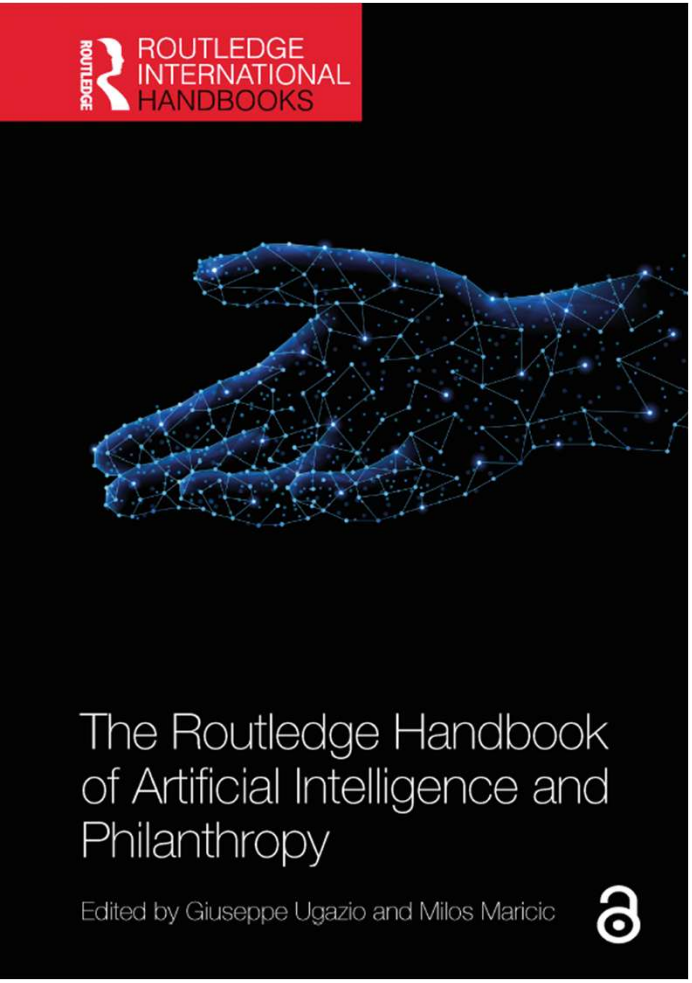
Por Que se Preocupar?

Competências Essenciais para a Era da IA

Co-construção de soluções relevantes para o setor filantrópico

Case In.Lab - InovaHC - Hospital das Clínicas FMUSP

Guirado et al., 2025



10

ARTIFICIAL INTELLIGENCE, MACHINE LEARNING, AND DATA SCIENCE PHILANTHROPY

Case studies of a purposive classification of philanthropic missions

Patricia Snell Herzog

LUDDY SCHOOL OF INFORMATICS, COMPUTING, AND ENGINEERING
INDIANA UNIVERSITY

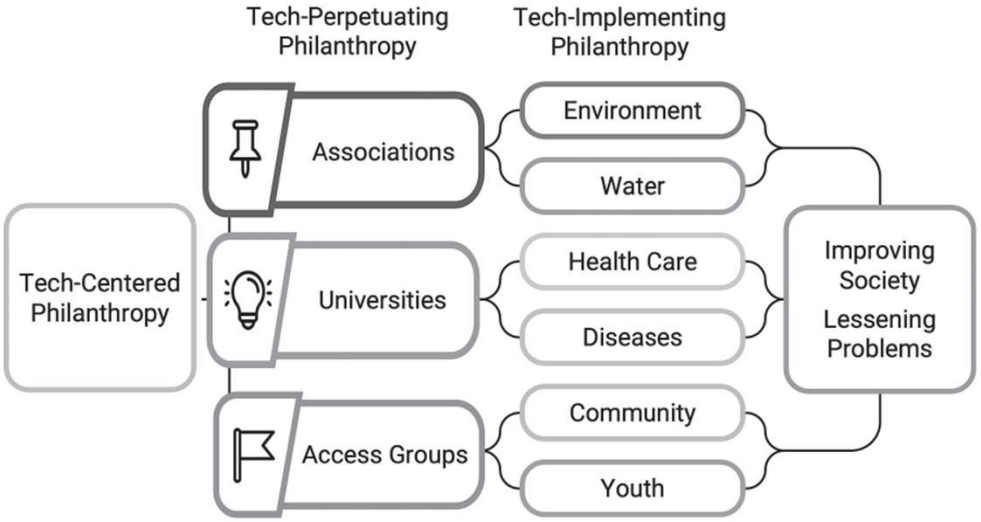
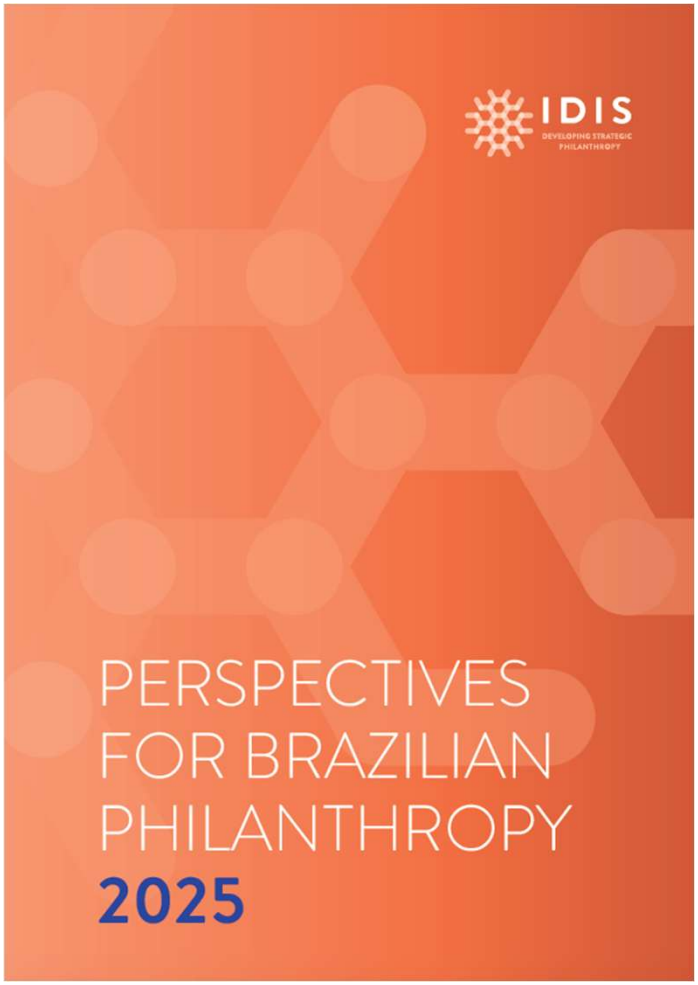


Figure 10.3 Framework for the three roles of philanthropy in technology for good activities.

Herzog, 2025

Guirado et al., 2025



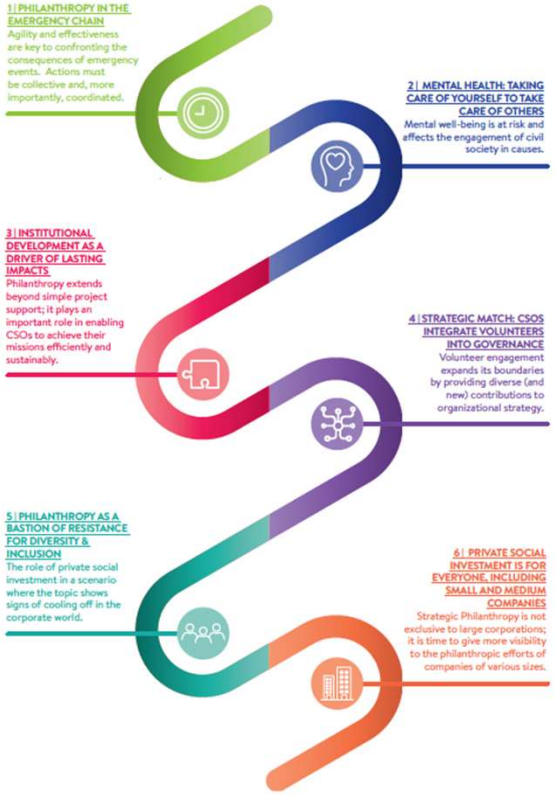
5) GOVERNANCE

Structuring boards, engaging board members with diverse and complementary profiles, transparency, and accountability, etc.

GIFE Governance Indicators

Based on the general guidelines of the Guide to Best Governance Practices for Business Institutes and Foundations, developed by GIFE – Group of Institutes, Foundations and Companies and the Brazilian Institute of Corporate Governance (IBGC), the self-assessment is conducted through an online questionnaire featuring numerical indicators. These indicators reflect the different levels of governance in areas such as the Deliberative Board, Financial Control and Supervision, Strategy and Management, Institutional Policies, Transparency, and Stakeholder Relations.

IDIS, 2025



Guirado et al., 2025

Sumário

Guirado et al., 2025

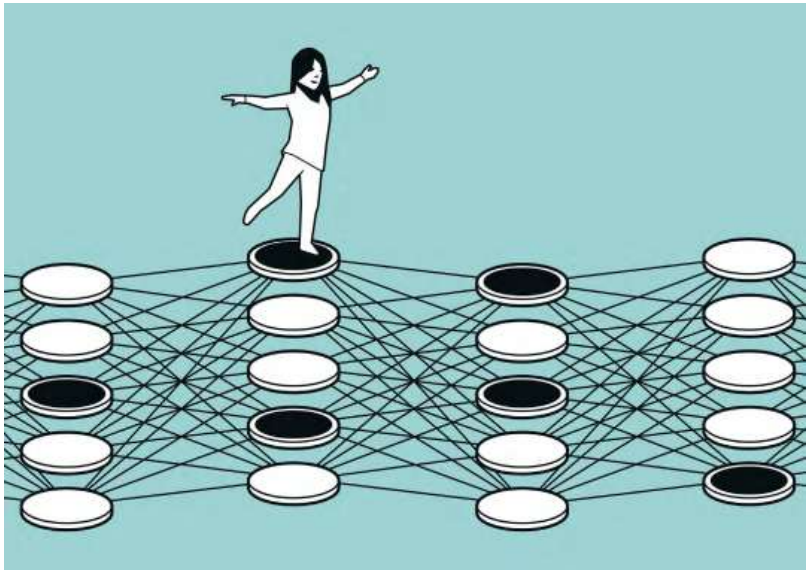
THE NOBEL PRIZE

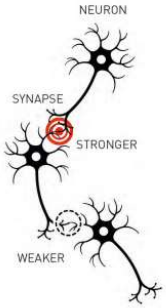
PHYSICS PRIZE 2024

•

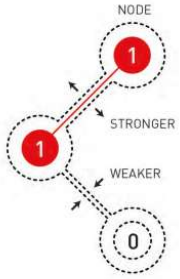
Inventions behind AI

Nobel Prize lessons





Natural neurons.



Artificial neurons.

John Hopfield
Born: 1933, USA

Geoffrey E. Hinton
Born: 1947, UK

"for foundational discoveries and inventions that enable machine learning with artificial neural networks"

Nobel, 2024

Guirado et al., 2025

science editing
pISSN 2288-8063
eISSN 2288-7474
Sci Ed 2024;11(2):142-148
https://doi.org/10.6087/kcse.338

Original Article

Publications on COVID-19 and artificial intelligence: trends and lessons

Yeong Jae Kim[1], Yang Liu[2], Youngeun Kim[1], Ho Won Jang[1,3]

[1]Department of Materials Science and Engineering, Research Institute of Advanced Materials, Seoul National University, Seoul, Korea; [2]School of Public Health, Nantong University, Nantong, China; [3]Advanced Institute of Convergence Technology, Seoul National University, Suwon, Korea

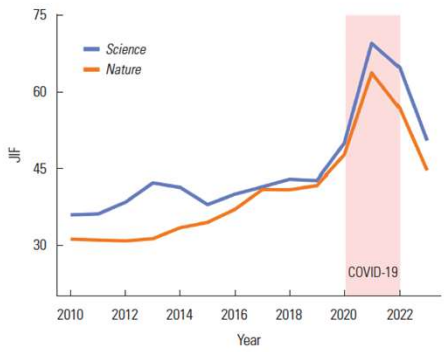


Fig. 2. Change of journal impact factors (JIFs) for *Science* and *Nature* per year. The COVID-19 period is marked in red.

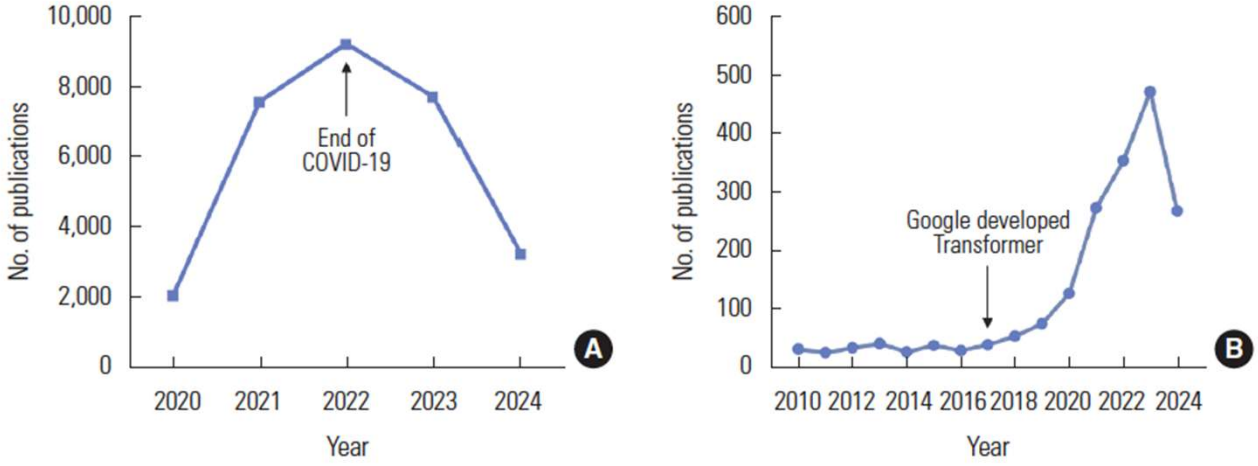


Fig. 1. Publications by year from the Web of Science database with keywords (A) "COVID-19" or "SARS-CoV-2" and (B) "artificial intelligence (AI)." The search was performed in mid of July 2024.

Kim et al., 2024

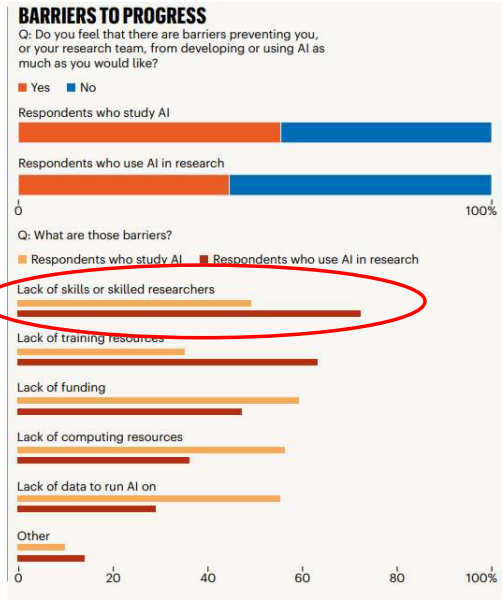
Guirado et al., 2025

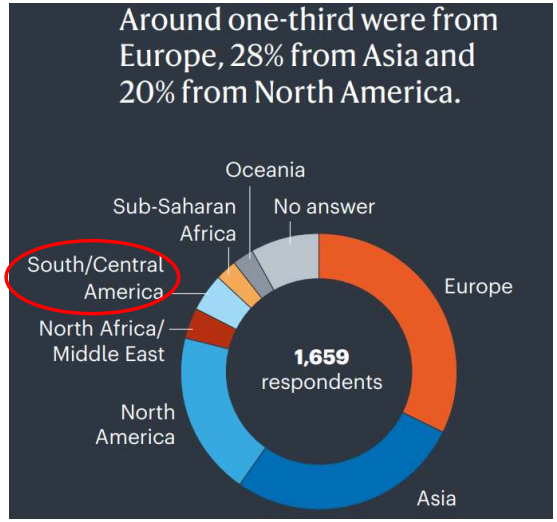
Feature

AI AND SCIENCE: WHAT 1,600 RESEARCHERS THINK

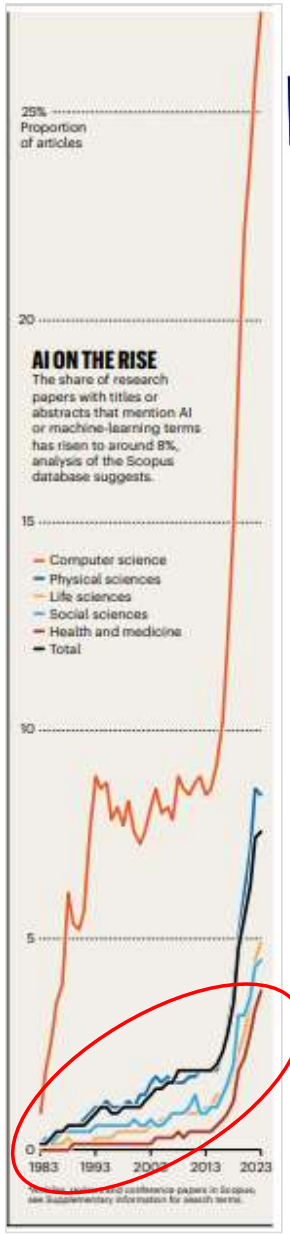
A *Nature* survey finds that scientists are concerned, as well as excited, by the increasing use of artificial-intelligence tools in research.

By Richard Van Noorden and Jeffrey M. Perkel





van Noorden & Perkel, 2023



Guirado et al., 2025

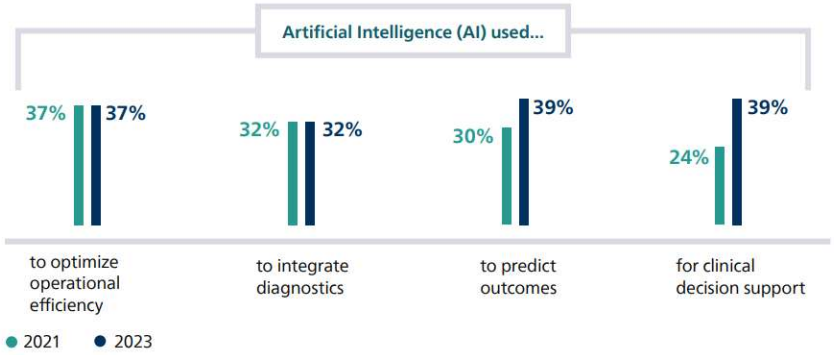


Figure 5: Top selected factors in the choice of workplace for younger healthcare professionals

1. **49%** Being at the forefront of artificial intelligence in healthcare
2. **44%** Being at the forefront of connected care delivery
3. **44%** A culture of collaboration
4. **42%** Professional autonomy
5. **41%** Availability of technology for everyday tasks

43% of younger healthcare professionals would feel more empowered to improve patient care based on closer collaboration with other organizations involved in care delivery

FHI, 2023

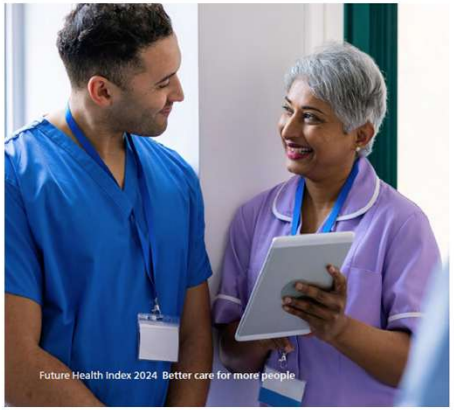
Guirado et al., 2025

future health index 2024

Better care for more people

Bridging the gaps in healthcare

Global report



87%

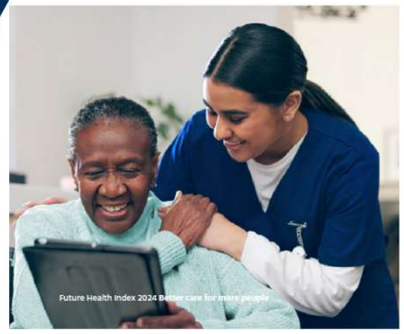
of healthcare leaders are concerned about the possibility of data bias in AI applications widening disparities in health outcomes

Strategies for mitigating risk of data bias in AI applications for healthcare:

48%	Making AI more transparent and interpretable
46%	Continuous training and education in AI
43%	Policies for ethical use of data and AI
41%	Bias detection and monitoring
38%	Ensuring staff diversity in data and AI
37%	Diverse and representative data collection

The AI evolution: from exploration to implementation

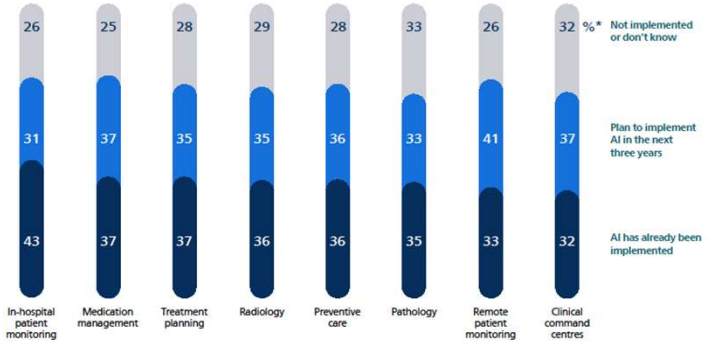
For the past few years, AI in healthcare has been an area of intense research and development. Now, it is increasingly finding its way into clinical practice. However, concerns about data bias remain.



Healthcare leaders are implementing AI from the hospital to the home

This year's Future Health Index findings show how healthcare leaders have already implemented AI for clinical decision support across different areas of the hospital, with in-hospital patient monitoring, medication management, treatment planning, radiology, and preventative care leading the pack. As healthcare leaders increasingly focus on expanding care beyond hospital walls, implementing AI in remote patient monitoring is an area of focus for the next three years.

Current and planned implementation of AI for clinical decision support



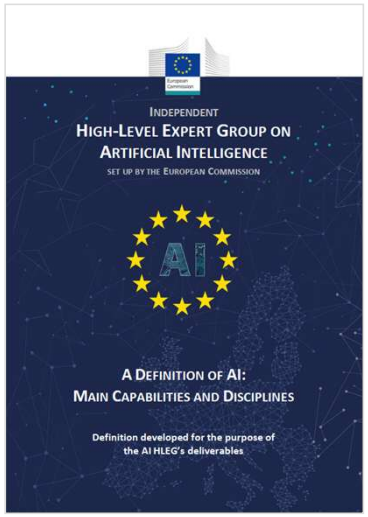
*Due to rounding, totals may add to more or less than 100%

17

FHI, 2024

Guirado et al., 2025

Definição

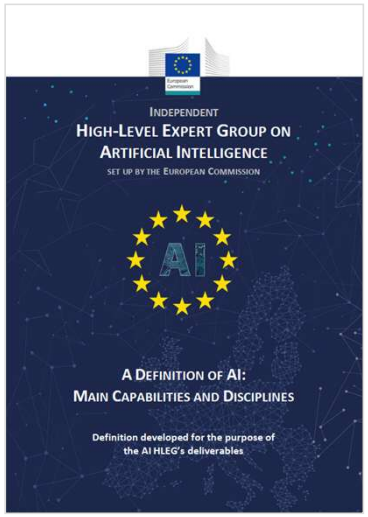


8 de abril de 2019

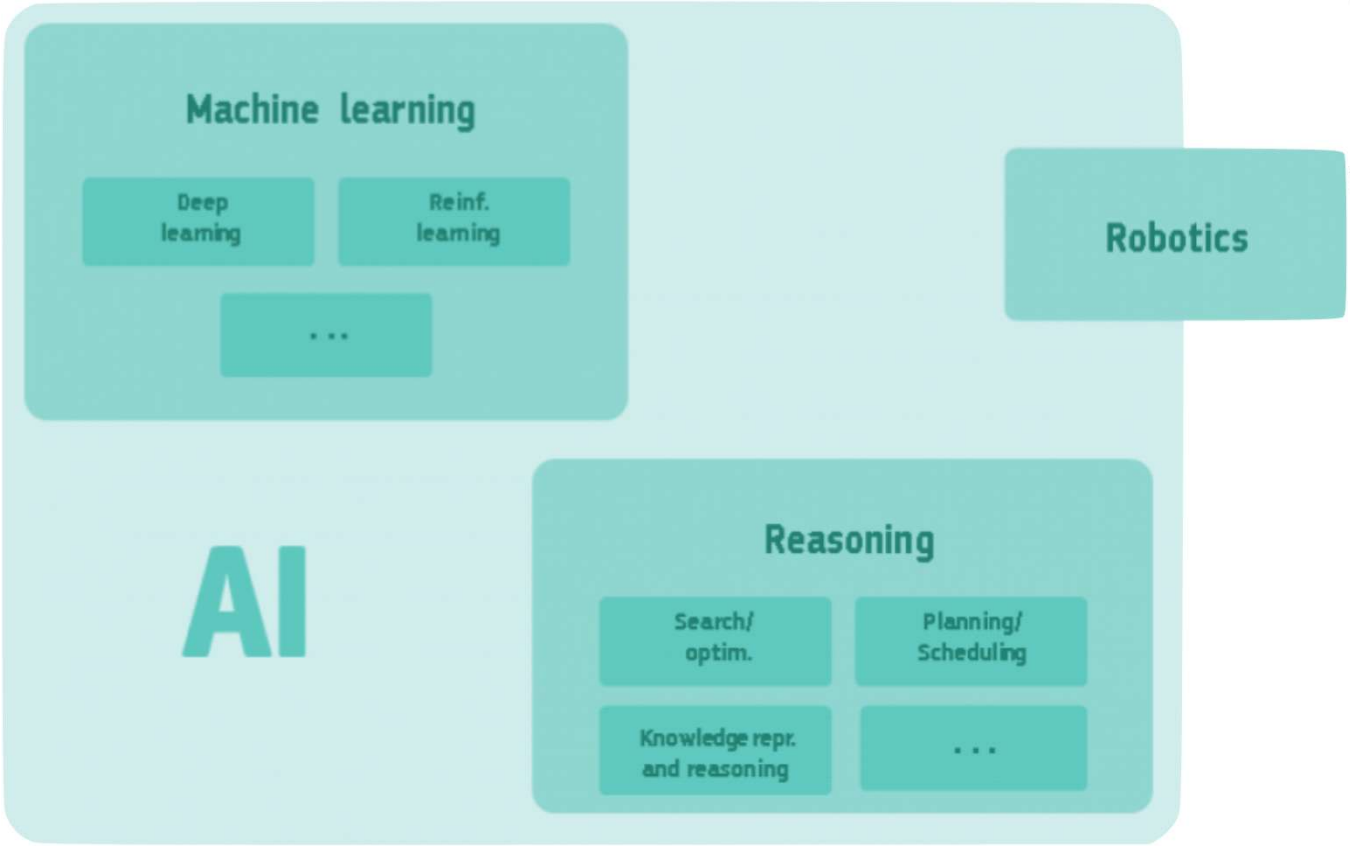
"Inteligência artificial (IA) refere-se a **sistemas que exibem comportamento inteligente ao analisar seu ambiente e tomar ações – com algum grau de autonomia – para atingir objetivos específicos**.

Os sistemas baseados em IA podem ser puramente baseados em software, atuando no mundo virtual (por exemplo, assistentes de voz, softwares de análise de imagens, mecanismos de busca, sistemas de reconhecimento de fala e facial) ou a IA pode ser incorporada em dispositivos de hardware (por exemplo, robôs avançados, carros autônomos, drones ou aplicativos da Internet das Coisas)."

UE, 2019

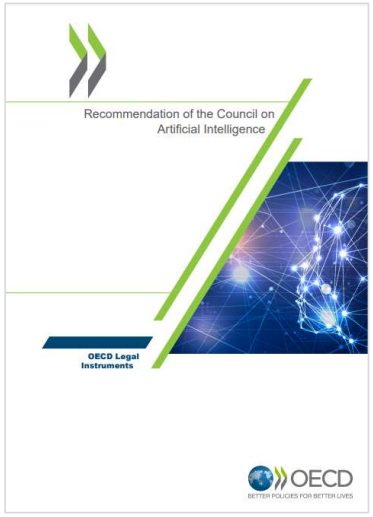


8 de abril de 2019



UE, 2019

Definição

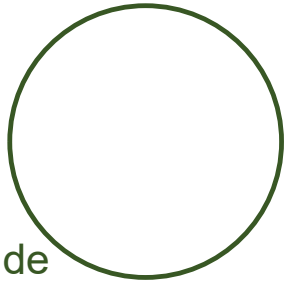


“[...] um sistema baseado em máquina que pode, para um conjunto de objetivos definidos por humanos, realizar predições, recomendações ou decisões, influenciando ambientes reais ou virtuais. Os sistemas de IA são projetados para operar com níveis variáveis de autonomia.”

OECD, 2024

Guirado et al., 2025

Definição

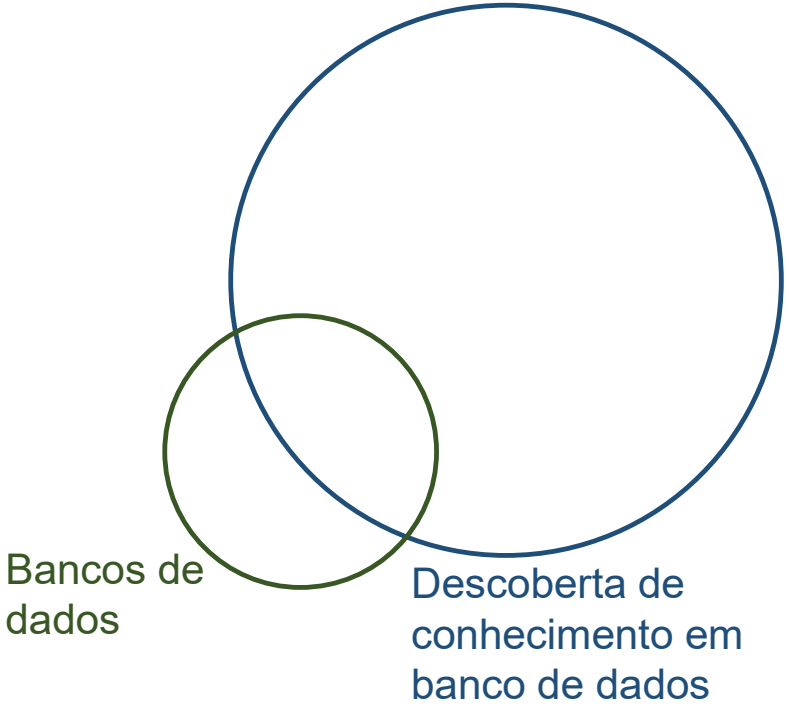


Bancos de dados

Miller & Brown, 2018

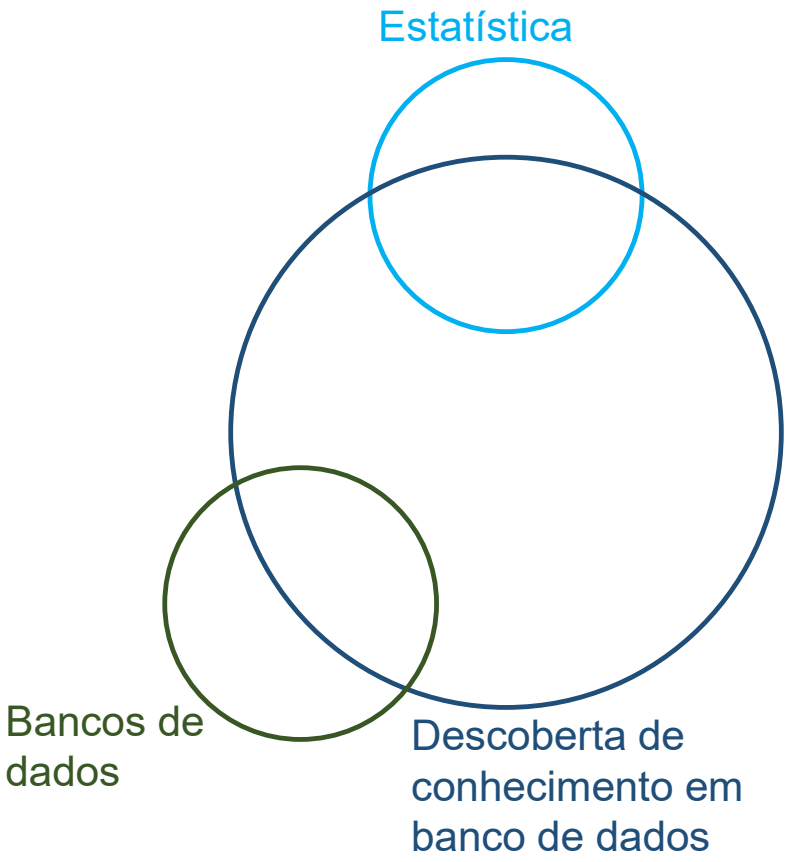
Guirado et al., 2025

Definição



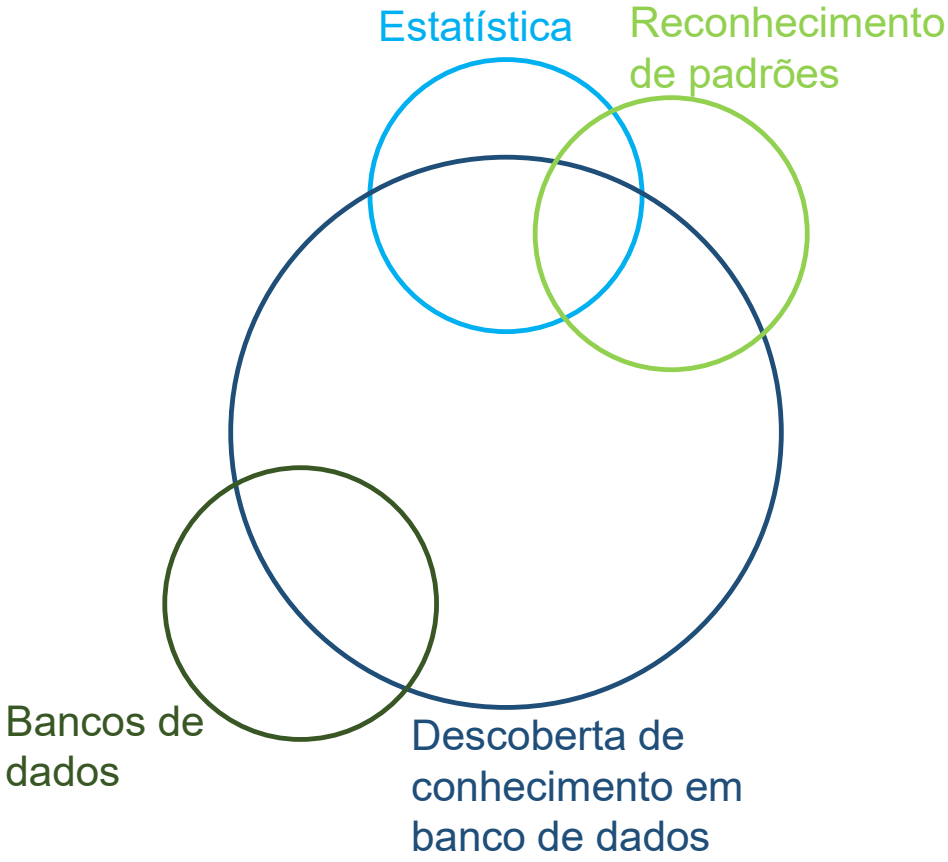
Miller & Brown, 2018

Definição



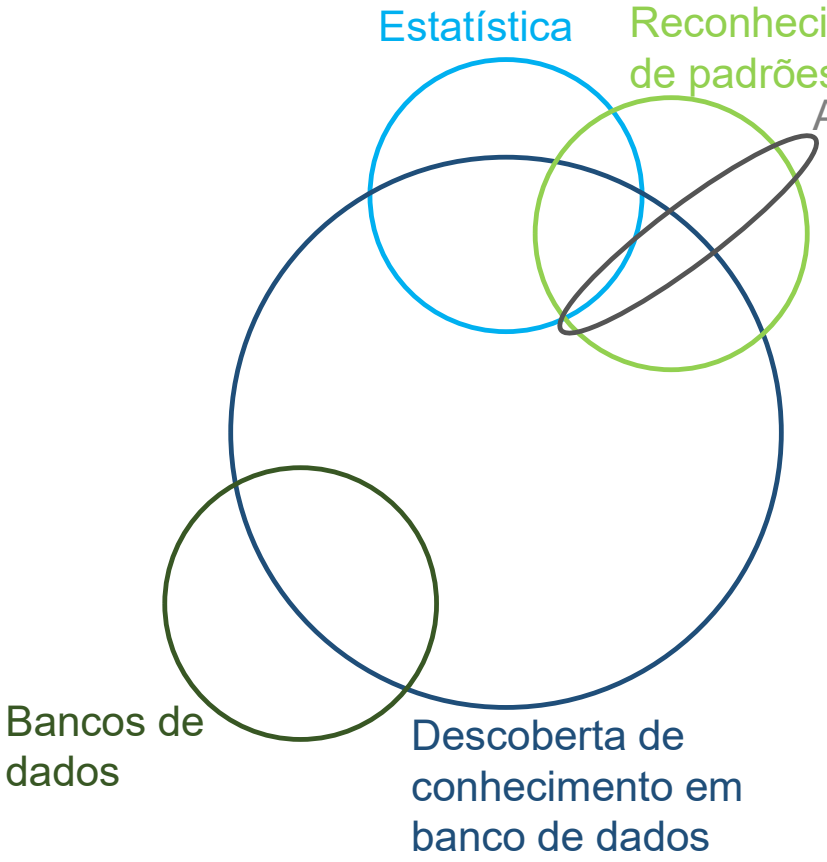
Miller & Brown, 2018

Definição



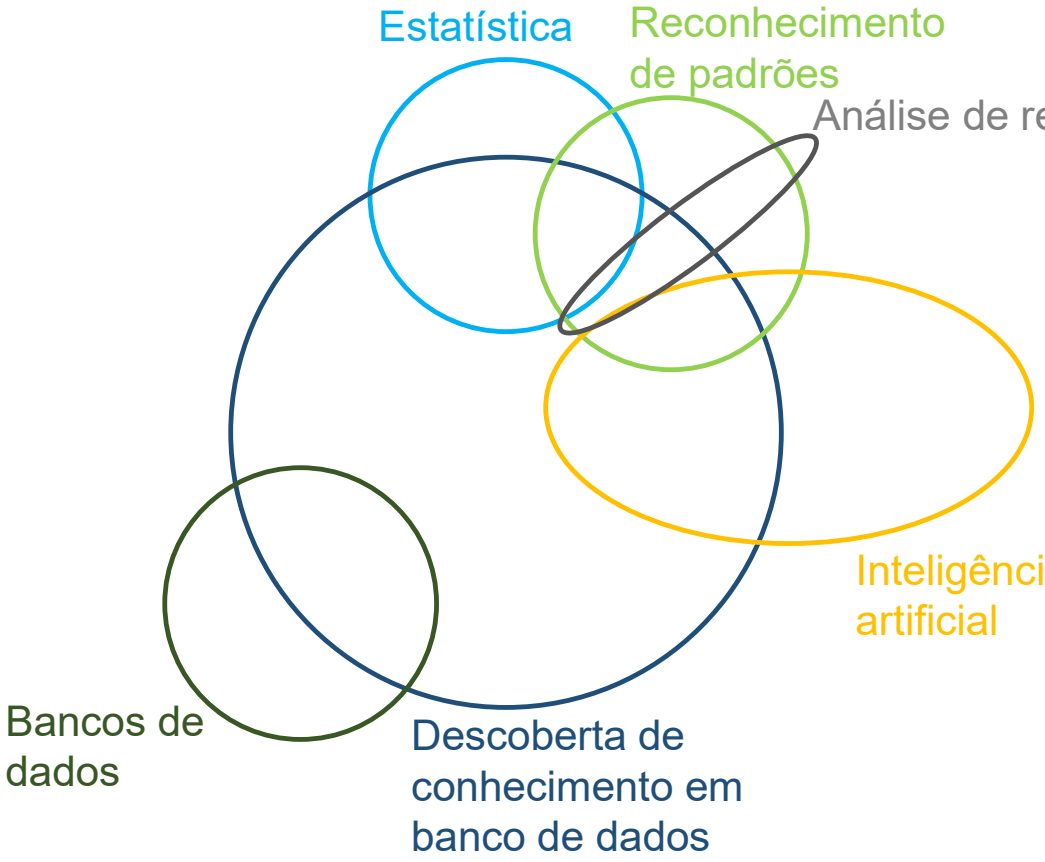
Miller & Brown, 2018

Definição



Miller & Brown, 2018

Definição

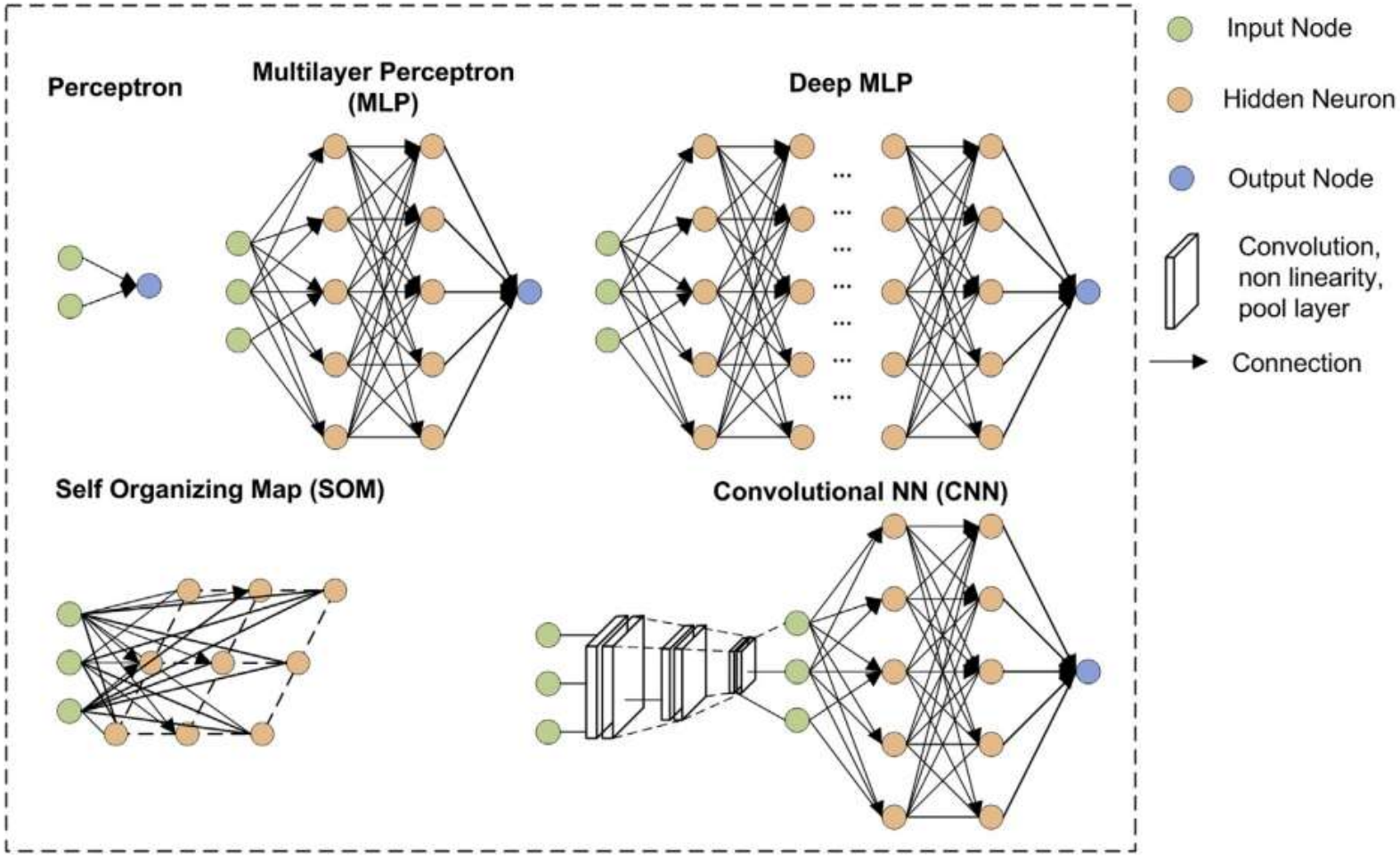


Miller & Brown, 2018

Definição

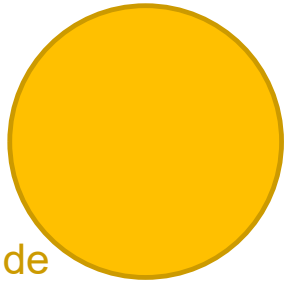
Miller & Brown, 2018

Definição



Grekousis, 2019

Definição



Bancos de dados

Miller & Brown, 2018

nature medicine

REVIEW ARTICLE

https://doi.org/10.1038/s41591-021-01614-0

Check for updates

AI in health and medicine

Pranav Rajpurkar[1,4], Emma Chen[2,4], Oishi Banerjee[2,4] and Eric J. Topol[3] ✉

Artificial intelligence (AI) is poised to broadly reshape medicine, potentially improving the experiences of both clinicians and patients. We discuss key findings from a 2-year weekly effort to track and share key developments in medical AI. We cover prospective studies and advances in medical image analysis, which have reduced the gap between research and deployment. We also address several promising avenues for novel medical AI research, including non-image data sources, unconventional problem formulations and human–AI collaboration. Finally, we consider serious technical and ethical challenges in issues spanning from data scarcity to racial bias. As these challenges are addressed, AI's potential may be realized, making healthcare more accurate, efficient and accessible for patients worldwide.

Box 1 | AI setups beyond supervised learning	
Self-supervised learning	Learning from unlabeled data by leveraging information extracted from the data itself
Semi-supervised learning	Learning from a small amount of labeled data combined with a large amount of unlabeled data
Causal inference	Finding the effect of a component or treatment on a system using data
Reinforcement learning	Learning in an interactive environment using feedback from actions and past experiences

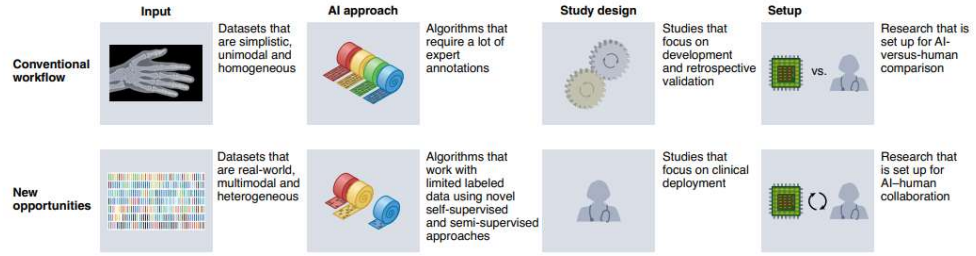


Fig. 2 | Opportunities for the development of AI algorithms.

Fig. 3 | Ethical challenges for AI in medicine.

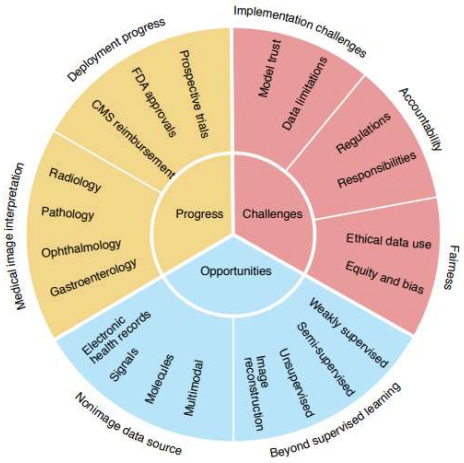


Fig. 1 | Overview of the progress, challenges and opportunities for AI in health. CMS, Centers for Medicare & Medicaid Services.

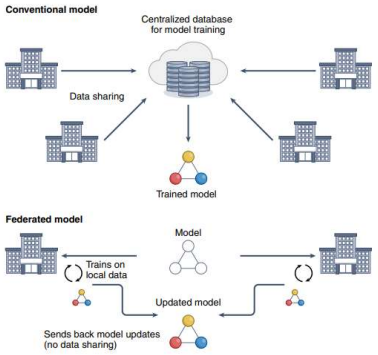


Fig. 4 | Evolving procedures for data sharing. An advantage of federated learning is that it is decentralized, representing a major potential advance in data security.

INTEGRANDO INTELIGÊNCIAS NA GESTÃO DA SAÚDE

15-17 ABR | 2025

ROYAL PALM HALL, CAMPINAS (SP)

34º CONGRESSO FEHOSP

fehosp

Rajpurkar et al., 2022

Guirado et al., 2025

IISE TRANSACTIONS ON HEALTHCARE SYSTEMS ENGINEERING
https://doi.org/10.1080/24725579.2021.1884627

Taylor & Francis
Taylor & Francis Group

OPEN ACCESS Check for updates

Health Care 4.0: A vision for smart and connected health care

Jingshan Li and Pascale Carayon

Department of Industrial and Systems Engineering, University of Wisconsin - Madison, Madison, WI, USA

indústria 1.0	indústria 2.0	indústria 3.0	indústria 4.0
mecanização energia a vapor	eletricidade produção em massa	robótica automação computadores	sistema ciber-físico internet das coisas fabricação em nuvem big data e inteligência artificial

Li & Carayon, 2021

IISE TRANSACTIONS ON HEALTHCARE SYSTEMS ENGINEERING
https://doi.org/10.1080/24725579.2021.1884627

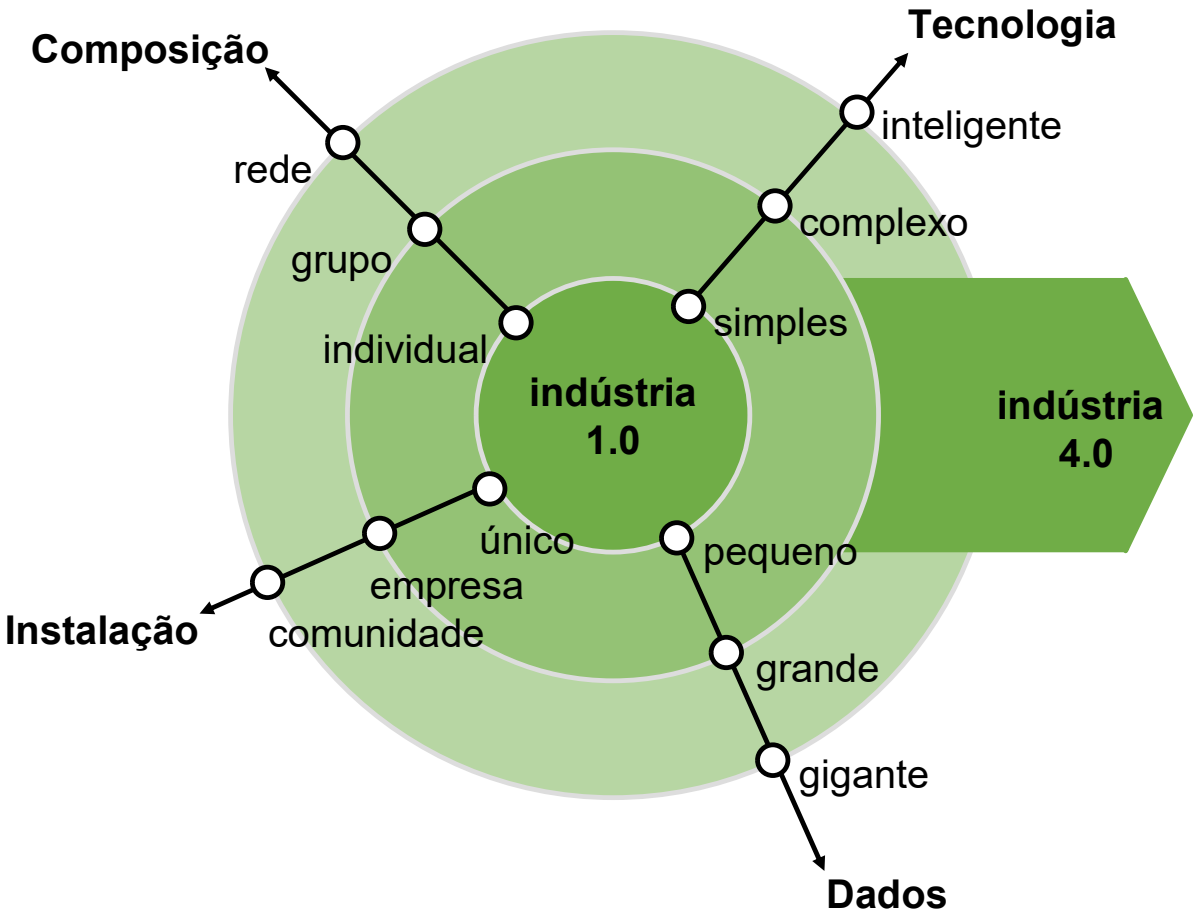
Taylor & Francis
Taylor & Francis Group

OPEN ACCESS Check for updates

Health Care 4.0: A vision for smart and connected health care

Jingshan Li and Pascale Carayon

Department of Industrial and Systems Engineering, University of Wisconsin - Madison, Madison, WI, USA



Li & Carayon, 2021

IISE TRANSACTIONS ON HEALTHCARE SYSTEMS ENGINEERING
https://doi.org/10.1080/24725579.2021.1884627

Taylor & Francis
Taylor & Francis Group

OPEN ACCESS Check for updates

Health Care 4.0: A vision for smart and connected health care

Jingshan Li and Pascale Carayon

Department of Industrial and Systems Engineering, University of Wisconsin - Madison, Madison, WI, USA

INTEGRANDO INTELIGÊNCIAS NA GESTÃO DA SAÚDE
15-17 ABR | 2025
ROYAL PALM HALL, CAMPINAS (SP)

34º CONGRESSO FEHOSP
fehosp

cuidado de saúde 1.0	cuidado de saúde 2.0	cuidado de saúde 3.0	cuidado de saúde 4.0
- encontro com o paciente - diagnóstico e tratamento	- equipamento médico - dispositivo de monitoramento	- prontuário eletrônico - entrada de pedido de provedor computadorizada - cuidados remotos e telessaúde	- saúde inteligente - cuidados conectados - medicina personalizada - **inteligência artificial**

Li & Carayon, 2021

IISE TRANSACTIONS ON HEALTHCARE SYSTEMS ENGINEERING
https://doi.org/10.1080/24725579.2021.1884627

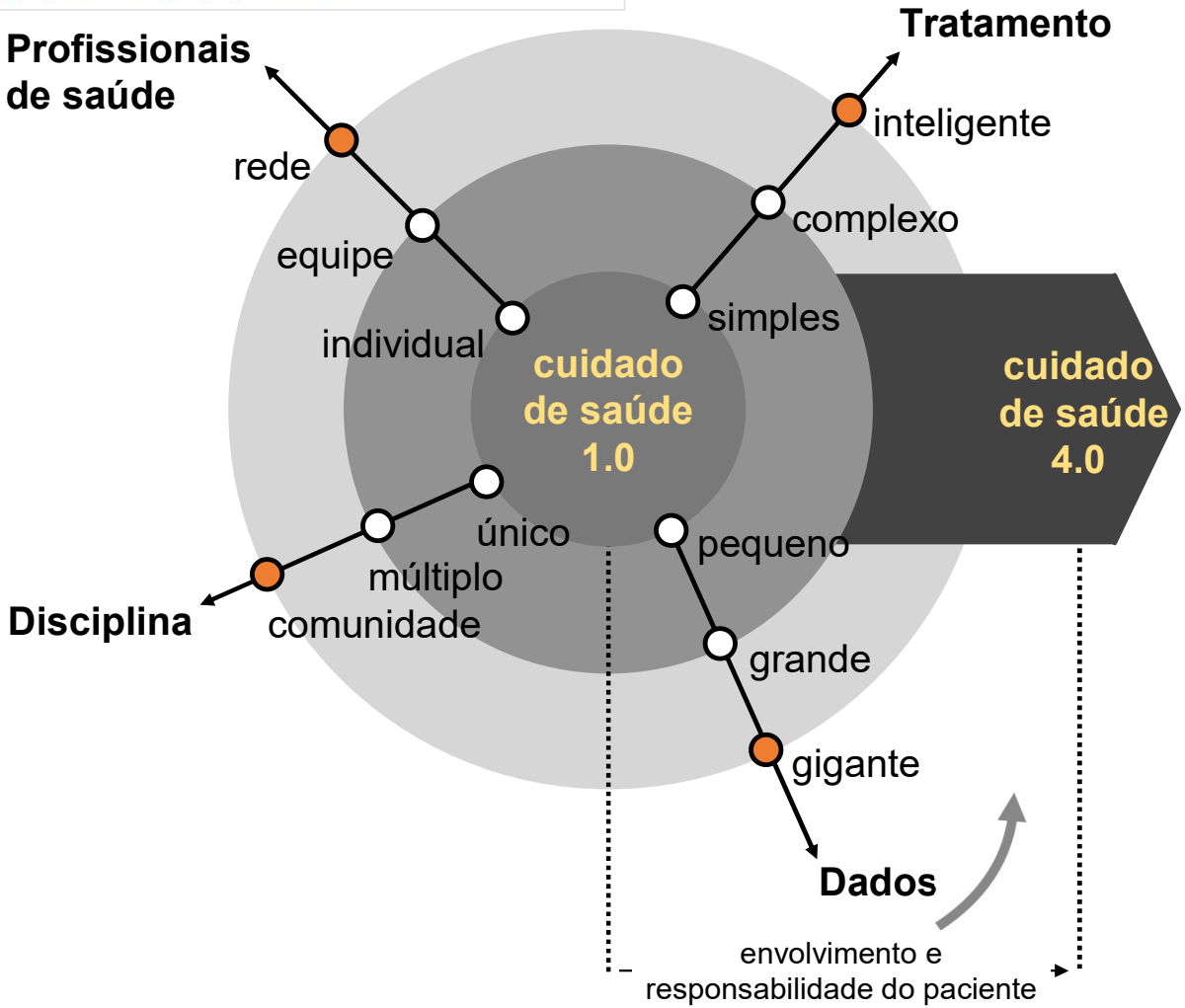
Taylor & Francis
Taylor & Francis Group

OPEN ACCESS Check for updates

Health Care 4.0: A vision for smart and connected health care

Jingshan Li and Pascale Carayon

Department of Industrial and Systems Engineering, University of Wisconsin - Madison, Madison, WI, USA



Li & Carayon, 2021

Guirado et al., 2025

nature communications

Article

https://doi.org/10.1038/s41467-024-51714-x

The global geography of artificial intelligence in life science research

Received: 8 June 2023

Accepted: 15 August 2024

Leo Schmallenbach[1], Till W. Bärnighausen[2,3,4] & Marc J. Lerchenmueller[1,5]

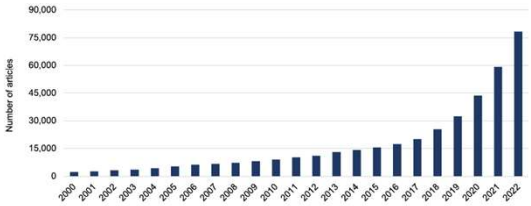


Fig. 1 | Evolution of the AI research enterprise in the life sciences. Yearly counts of articles ($n = 397{,}967$) with AI-related keywords in titles or abstracts from 2000 to 2022. Growth refers to the compound annual growth rate (CAGR 2010–2022). Source data are provided as a Source Data file.

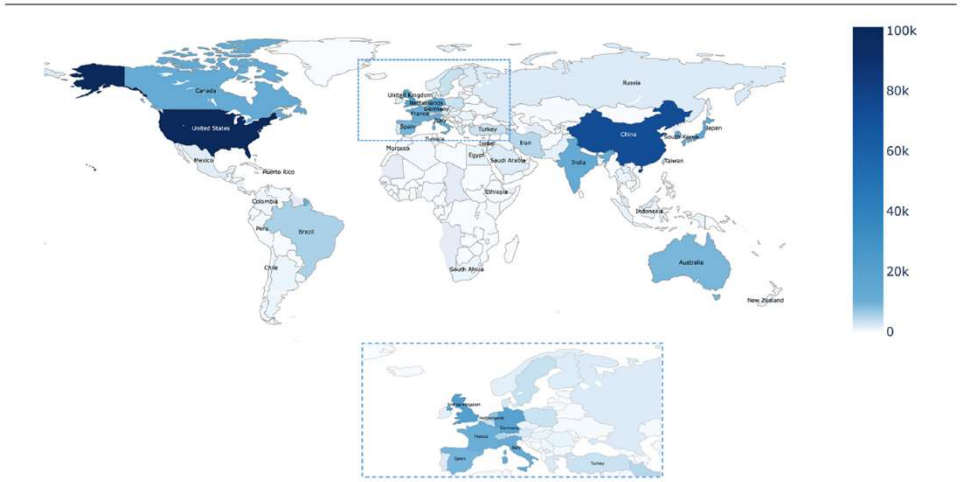


Fig. 2 | Geography of the AI life science research enterprise in terms of productivity. Counts of AI-focused life science articles by country, cumulated for the years 2000 to 2022 ($n = 397{,}967$). Source data are provided as a Source Data file.

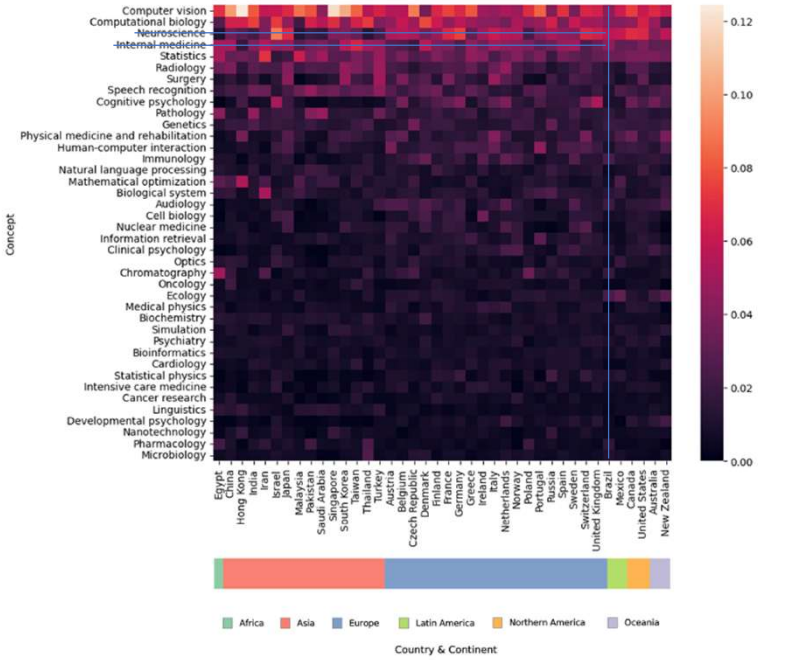


Fig. 3 | Heatmap of relative country focus with respect to publication topics. The horizontal axis enlists the 40 most productive countries grouped by geographic region. The vertical axis depicts the underlying publication topics in descending order (computer vision being the most frequently researched topic). The color scheme of the heatmap reflects the percentage share of country-specific productivity for a given publication topic ($n = 397{,}967$). Source data are provided as a Source Data file.

Schmallenbach, Bärnighausen & Lerchenmueller, 2024

Guirado et al., 2025

npj | Digital Medicine

www.nature.com/npjdigitalmed

ARTICLE OPEN

Check for updates

The state of artificial intelligence-based FDA-approved medical devices and algorithms: an online database

Stan Benjamens[1,2], Pranavsingh Dhunnoo[3] and Bertalan Meskó[3,4]✉

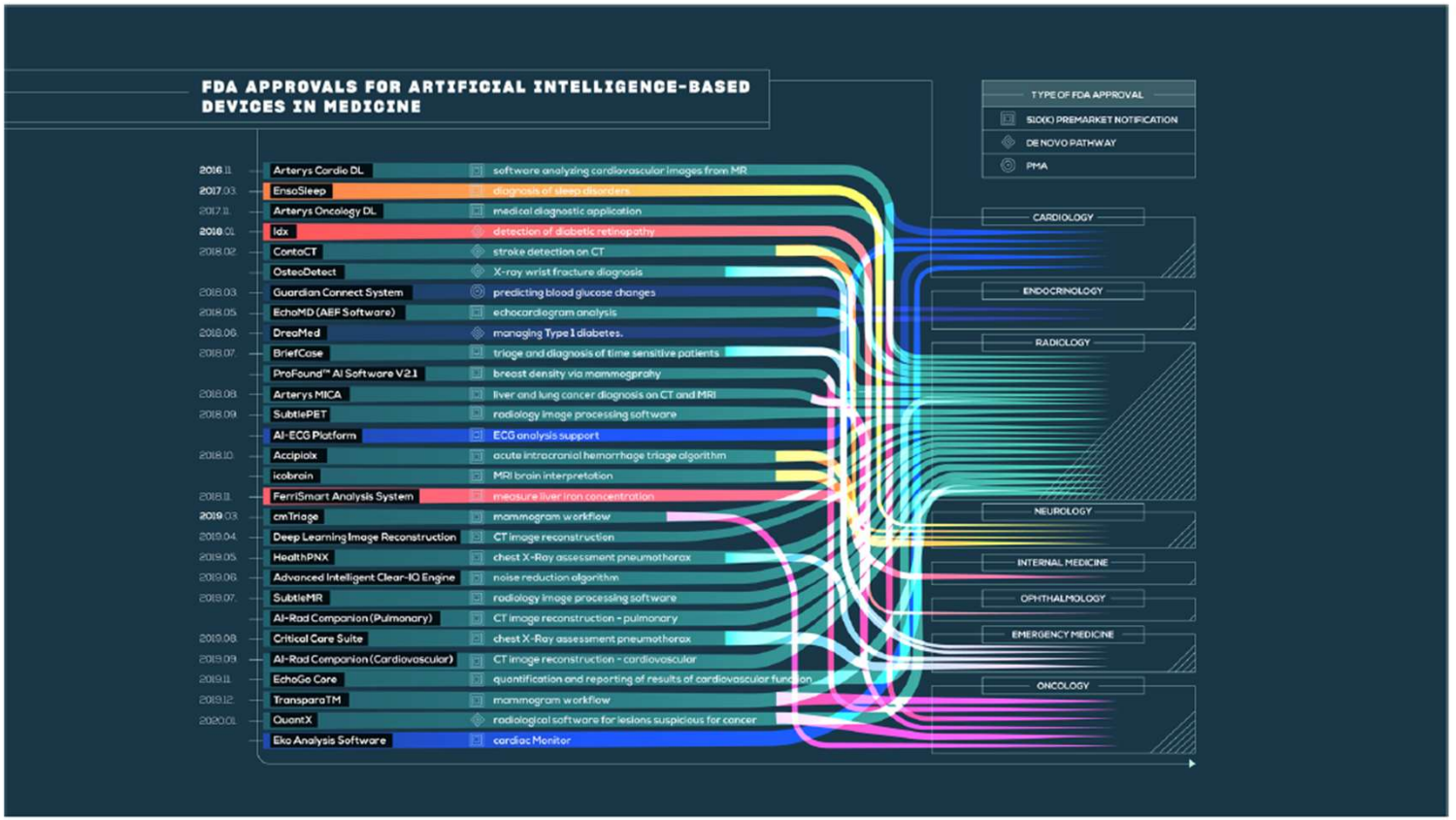


Fig. 1 An infographic about the 29 FDA-approved, AI/ML-based medical technologies. The devices have features such as date and type of FDA approval; name of the device, its short description and which primary and secondary medical specialty it is related to.

Benjamens, Dhunnoo & Meskó, 2020

Guirado et al., 2025

electronics

MDPI

Article

FDA-Approved Artificial Intelligence and Machine Learning (AI/ML)-Enabled Medical Devices: An Updated Landscape

Geeta Joshi [1,2], Aditi Jain [3], Shalini Reddy Araveeti [4], Sabina Adhikari [5], Harshit Garg [1] and Mukund Bhandari [6,*]

[1] Department of Urology, UTHealth San Antonio, San Antonio, TX 78229, USA; joshig@uthscsa.edu (G.J.); gargh@uthscsa.edu (H.G.)
[2] Department of Medical Education, UTHealth San Antonio, San Antonio, TX 78229, USA
[3] Department of Obstetrics and Gynecology, UTHealth San Antonio, San Antonio, TX 78229, USA
[4] New England College, Henniker, NH 03242, USA
[5] Department of Computer Science, Texas A&M University, College Station, TX 77843, USA; adhikaris3@tamu.edu
[6] Greehey Children Cancer Research Institute, UTHealth San Antonio, San Antonio, TX 78229, USA

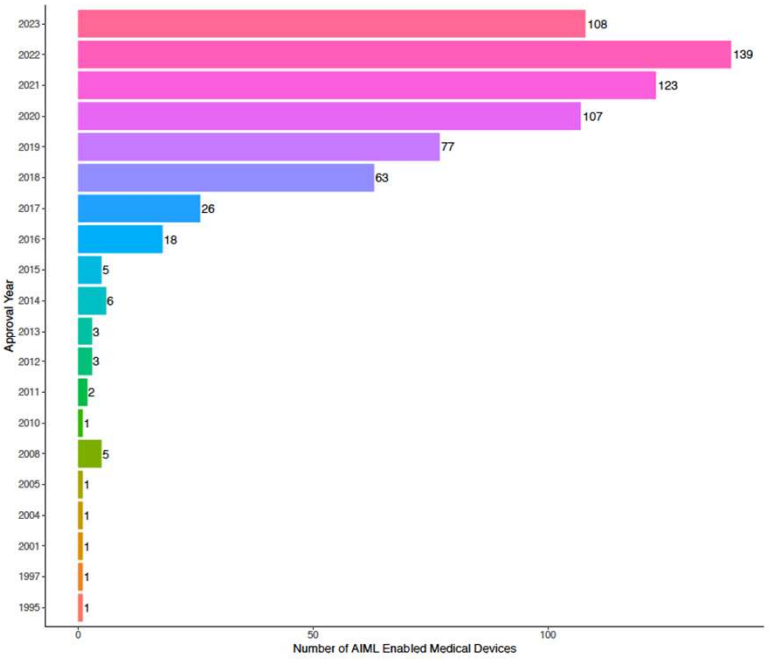


Figure 2. Graphical representation of the annual trends in FDA approval for AI/ML-enabled medical devices showcasing the surge in technological integration in healthcare.

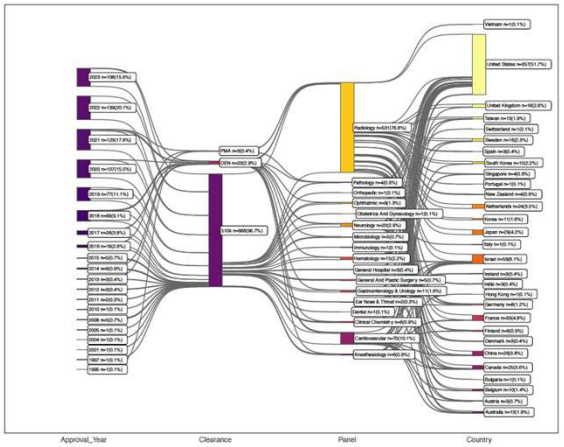
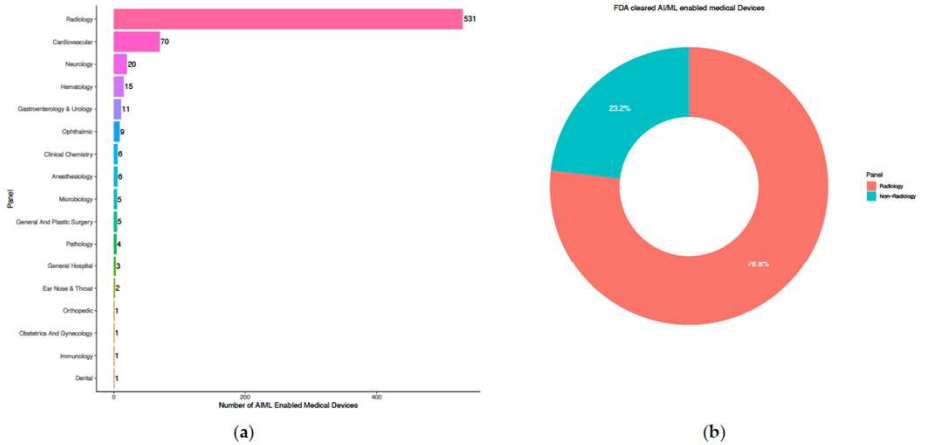


Figure 10. Comprehensive summary chart of AI/ML-Enabled Medical Devices approved by the FDA, encapsulating key information from approval trends to device types and clearance pathways.



(a) (b)

Figure 3. (a) Bar graph showing the number of approved devices categorized by medical panels, emphasizing the diversification and expansion of AI/ML applications across different medical specialties; (b) Donut plot illustrating the substantial dominance of radiology in the number of AI/ML-enabled device approvals compared to other medical specialties, underlining the field's innovation-driven nature.

Joshi et al., 2024

Guirado et al., 2025

npj | digital medicine

Article

Published in partnership with Seoul National University Bundang Hospital

https://doi.org/10.1038/s41746-024-01270-x

A scoping review of reporting gaps in FDA-approved AI medical devices

Check for updates

Vijaytha Muralidharan[1,13], Boluwatife Adeleye Adewale[2,3,13], Caroline J. Huang[4], Mfon Thelma Nta[5], Peter Oluwaduyilemi Ademiju[6], Pirunthan Pathmarajah[1], Man Kien Hang[7,8], Oluwafolajimi Adesanya[9], Ridwanullah Olamide Abdullateef[10,11], Abdulhammed Opeyemi Babatunde[10], Abdulquddus Ajibade[10], Sonia Onyeka[1], Zhou Ran Cai[1], Roxana Daneshjou[1,12,14] & Tobi Olatunji[6,14]

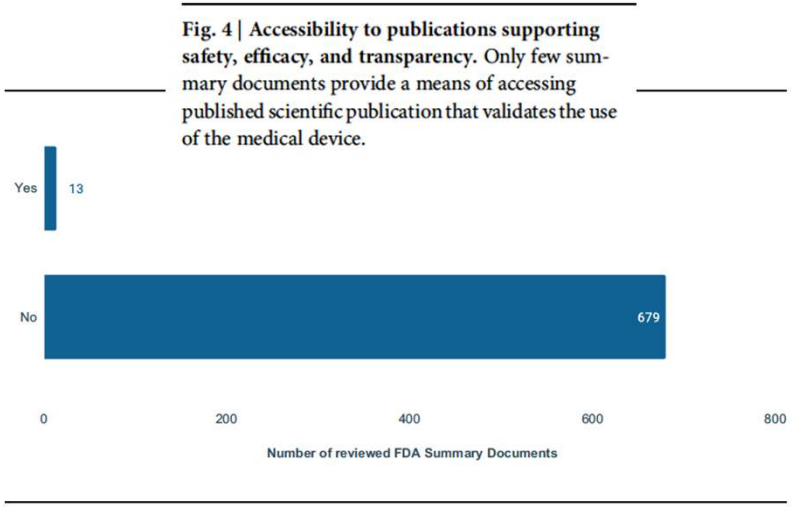


Fig. 4 | Accessibility to publications supporting safety, efficacy, and transparency. Only few summary documents provide a means of accessing published scientific publication that validates the use of the medical device.

Machine learning and artificial intelligence (AI/ML) models in healthcare may exacerbate health biases. Regulatory oversight is critical in evaluating the safety and effectiveness of AI/ML devices in clinical settings. We conducted a scoping review on the 692 FDA-approved AI/ML-enabled medical devices approved from 1995-2023 to examine transparency, safety reporting, and sociodemographic representation. Only 3.6% of approvals reported race/ethnicity, 99.1% provided no socioeconomic data. 81.6% did not report the age of study subjects. Only 46.1% provided comprehensive detailed results of performance studies; only 1.9% included a link to a scientific publication with safety and efficacy data. Only 9.0% contained a prospective study for post-market surveillance. Despite the growing number of market-approved medical devices, our data shows that FDA reporting data remains inconsistent. Demographic and socioeconomic characteristics are underreported, exacerbating the risk of algorithmic bias and health disparity.

Muralidharan et al., 2024

Guirado et al., 2025

npj | digital medicine

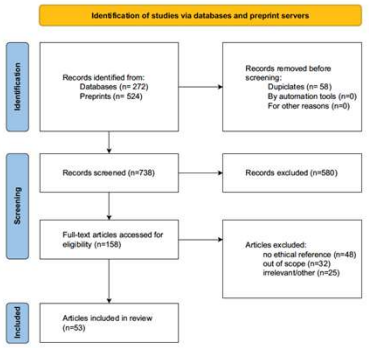
Review article

Published in partnership with Seoul National University Bundang Hospital

https://doi.org/10.1038/s41746-024-01157-x

The ethics of ChatGPT in medicine and healthcare: a systematic review on Large Language Models (LLMs)

Joschka Haltaufderheide & Robert Ranisch



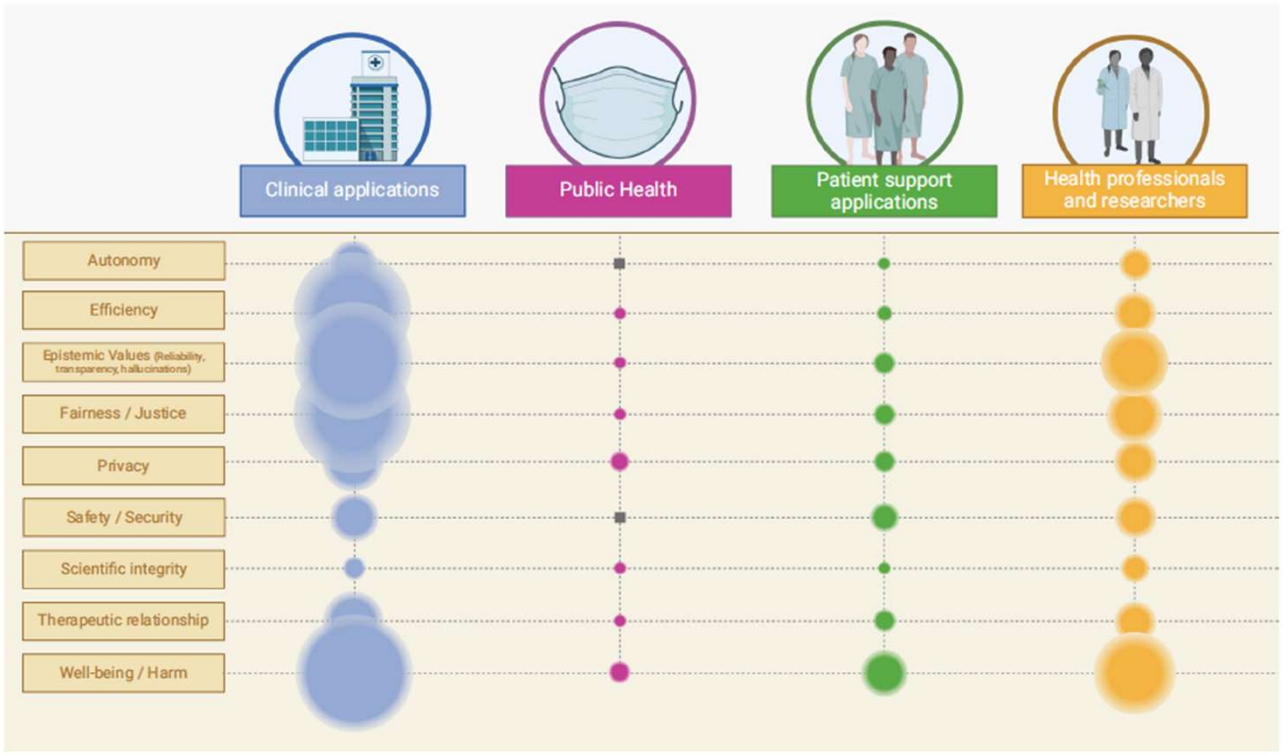


Fig. 3 | Discussed dimensions of impact of LLMs. This figure shows recurring ethical issues and their relative weight in each field of application based on the number of codes extracted during the analysis.

Haltaufderheide & Ranisch, 2024

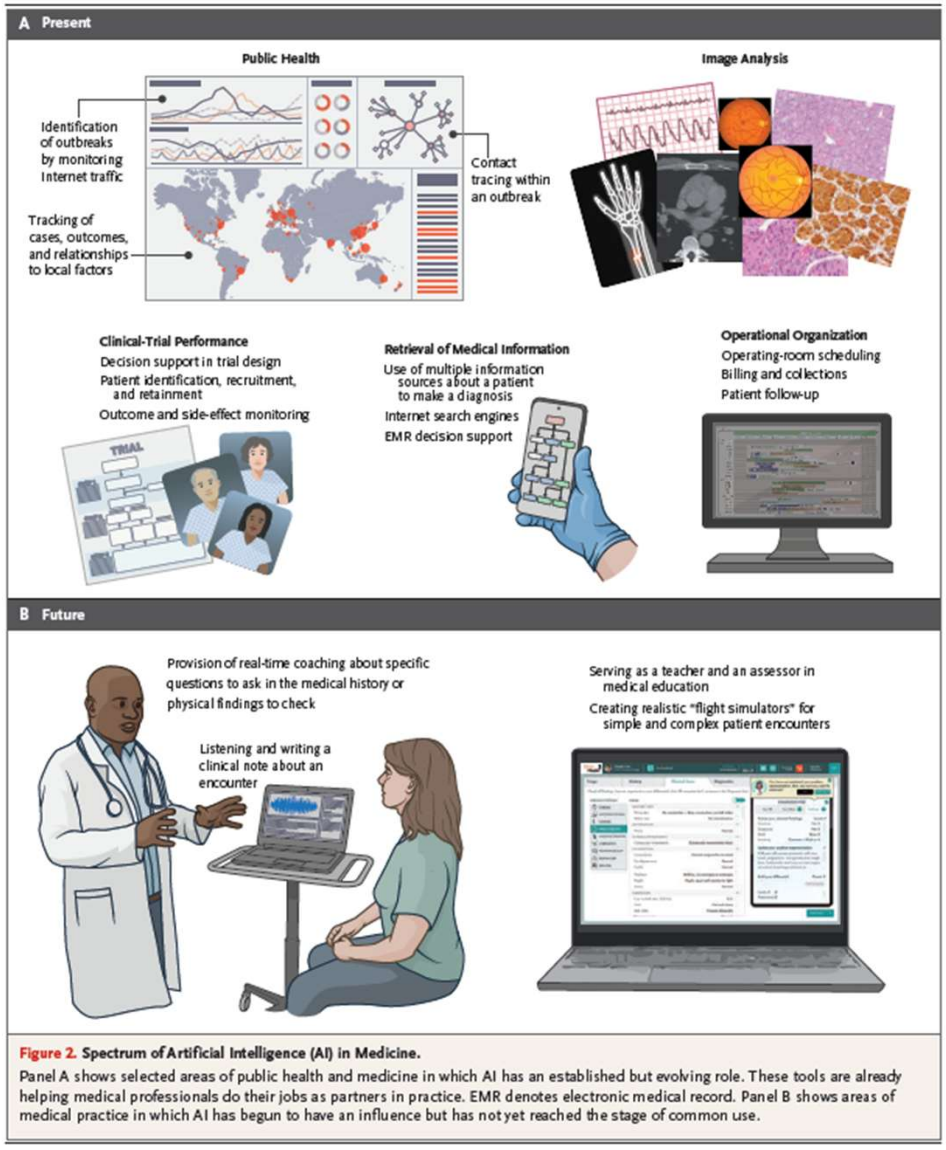


Figure 2. Spectrum of Artificial Intelligence (AI) in Medicine.
Panel A shows selected areas of public health and medicine in which AI has an established but evolving role. These tools are already helping medical professionals do their jobs as partners in practice. EMR denotes electronic medical record. Panel B shows areas of medical practice in which AI has begun to have an influence but has not yet reached the stage of common use.

The NEW ENGLAND JOURNAL of MEDICINE

EDITORIALS

Artificial Intelligence in Medicine

Andrew L. Beam, Ph.D., Jeffrey M. Drazen, M.D., Isaac S. Kohane, M.D., Ph.D., Tze-Yun Leong, Ph.D., Arjun K. Manrai, Ph.D., and Eric J. Rubin, M.D., Ph.D.

The NEW ENGLAND JOURNAL of MEDICINE

REVIEW ARTICLE

Jeffrey M. Drazen, M.D., *Editor;*
Isaac S. Kohane, M.D., Ph.D., and Tze-Yun Leong, Ph.D., *Guest Editors*

AI IN MEDICINE

Artificial Intelligence and Machine Learning in Clinical Medicine, 2023

Charlotte J. Haug, M.D., Ph.D., and Jeffrey M. Drazen, M.D.

Haug & Drazen, 2023

Guirado et al., 2025

Art. 3º O desenvolvimento, a implementação e o uso de sistemas de inteligência artificial observarão a boa-fé e os seguintes princípios:

I – crescimento inclusivo, desenvolvimento sustentável e bem-estar;

II – autodeterminação e liberdade de decisão e de escolha;

III – participação humana no ciclo da inteligência artificial e supervisão humana efetiva; ← governança

IV – não discriminação; ← viés

V – justiça, equidade e inclusão;

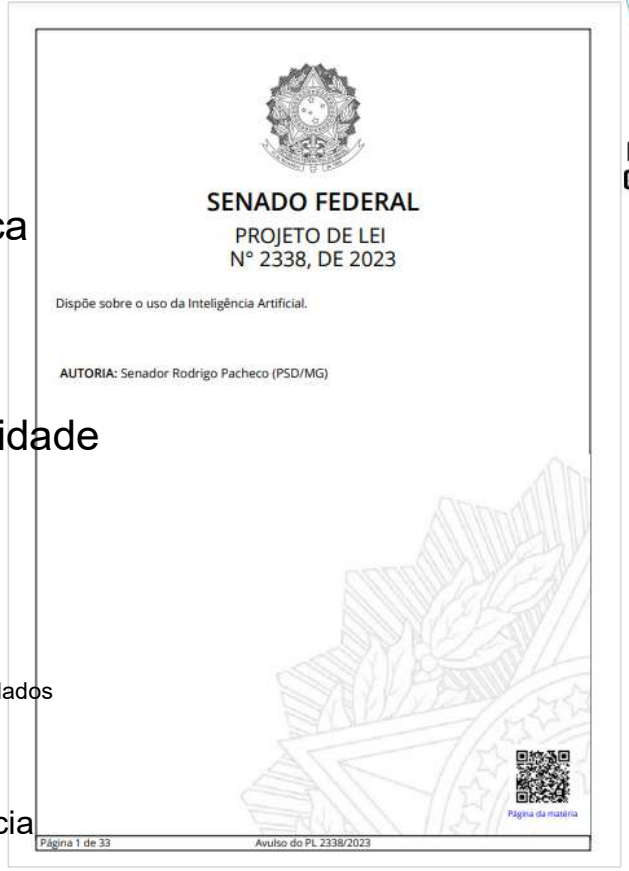
VI – transparência, explicabilidade, inteligibilidade e auditabilidade; ← explicabilidade

VII – confiabilidade e robustez dos sistemas de inteligência artificial e segurança da informação;

VIII – devido processo legal, contestabilidade e contraditório; ← risco

IX – rastreabilidade das decisões durante o ciclo de vida de sistemas de inteligência artificial como meio de prestação de contas e atribuição de responsabilidades a uma pessoa natural ou jurídica; ← Governança de dados e ciclo de vida

X – prestação de contas, responsabilização e reparação integral de danos; ← Risco e transparência



SENADO FEDERAL

PROJETO DE LEI
Nº 2338, DE 2023

Dispõe sobre o uso da Inteligência Artificial.

AUTORIA: Senador Rodrigo Pacheco (PSD/MG)

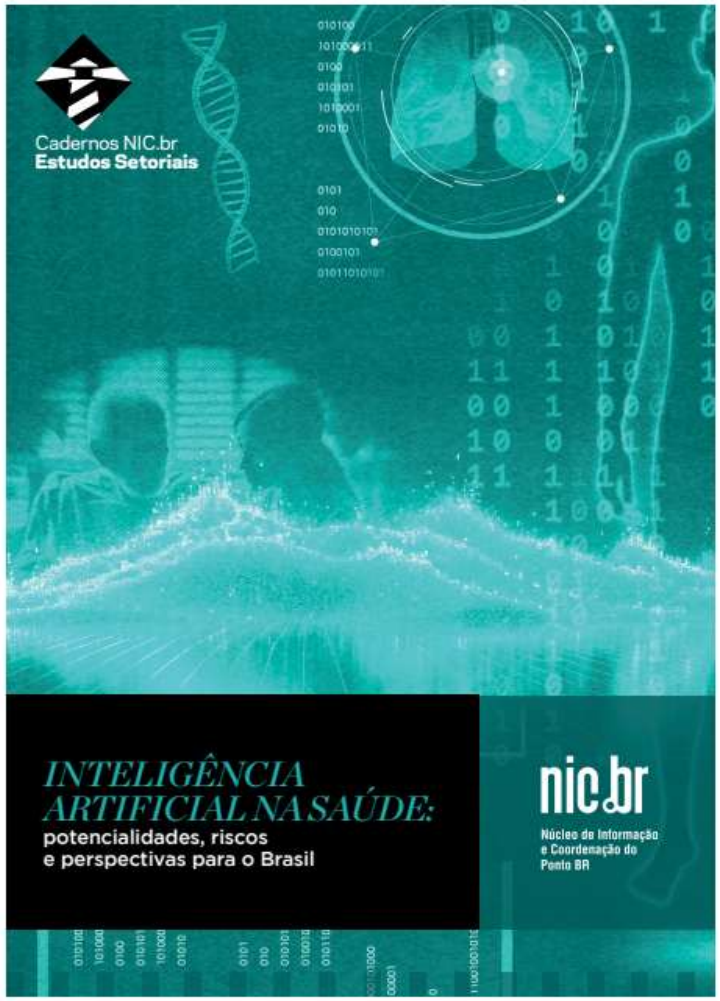
Página da matéria

Página 1 de 33 Avulso do PL 2338/2023

Center for Artificial Intelligence — A research center to advance artificial intelligence in Brazil

Senado Federal, 2023 (10/12/2024)

Guirado et al., 2025



nic.br cgi.br

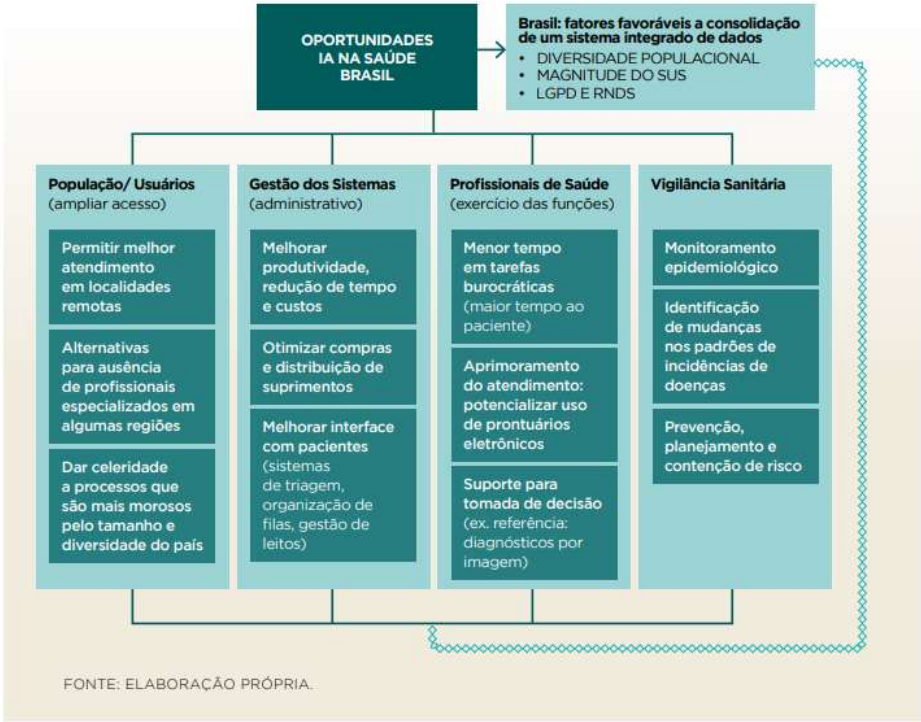
SUMÁRIO

CRÉDITOS DA EDIÇÃO
COORDENAÇÃO EXECUTIVA E EDITORIAL: Alexandre F. Barbosa (Cetic.br|NIC.br)
COORDENAÇÃO CIENTÍFICA: Heimar de Fátima Marin
COORDENAÇÃO TÉCNICA: Graziela Castello, Rodrigo Brandão de Andrade e Silva, Mariana Galhardo Oliveira e Javiera F. Medina Macaya (Cetic.br|NIC.br)
GESTÃO DA PESQUISA EM CAMPO: Monise Picanço, Priscila Viera, Marina Castro de Oliveira e Florbela Ribeiro (Centro Brasileiro de Análise e Planejamento [CEBRAP])
APOIO À EDIÇÃO: Carolina Carvalho e Leandro Esmeladi Espindola (Comunicação|NIC.br)
PREPARAÇÃO E REVISÃO EM PORTUGUÊS: Érica Santos Soares de Freitas
TRADUÇÃO: Ana Zuleika Pinheiro Machado
PROJETO GRÁFICO E ILUSTRAÇÕES: Pilar Velloso
DIAGRAMAÇÃO: Milena Branco
FOTOS: Shutterstock

Esta publicação está disponível também em formato digital. As ideias e opiniões expressas nos artigos autorais são as dos respectivos autores e não refletem necessariamente as do NIC.br e do CGI.br.

O trabalho de campo foi realizado entre os meses de agosto e dezembro de 2023. As entrevistas tiveram duração média de uma hora e foram realizadas remotamente, a partir de videochamadas previamente agendadas com os atores recrutados. Todas as entrevistas foram gravadas e transcritas para posterior codificação do material.

FIGURA 2 – OPORTUNIDADES DA IA NA SAÚDE NO BRASIL



FONTE: ELABORAÇÃO PRÓPRIA.

Nic.br, 2024

Guirado et al., 2025

Sumário

Guirado et al., 2025

JMIR MEDICAL EDUCATION Weidener & Fischer

Original Paper

Artificial Intelligence in Medicine: Cross-Sectional Study Among Medical Students on Application, Education, and Ethical Aspects

Lukas Weidener, BSc, Dr med; Michael Fischer, PhD

Research Unit for Quality and Ethics in Health Care, UMIT TIROL – Private University for Health Sciences and Health Technology, Hall in Tirol, Austria

UMIT TIROL
THE TYROLEAN PRIVATE UNIVERSITY

Table 7. Statistical analysis of the relevance of artificial intelligence (AI)–based (chat) applications such as ChatGPT (OpenAI), Bard (Google), Bing Chat (Microsoft Inc), and Jasper Chat (Jasper AI, Inc) ethics teaching contents according to the participating medical students (n=487).

AI ethics teaching content and subgroup	Scores, median (IQR)	Scores, mode	*P* value	*Z* score
TC1: informed consent			.04	2.018
Subgroup 1: previous use of AI	4 (4-5)	5		
Subgroup 2: no previous use of AI	4 (3-4)	4		
TC2: bias			.22	−1.215
Subgroup 1: previous use of AI	4 (4-5)	5		
Subgroup 2: no previous use of AI	4 (3-4)	4		
TC3: data privacy			.78	0.283
Subgroup 1: previous use of AI	4 (4-5)	5		
Subgroup 2: no previous use of AI	4 (4-5)	5		
TC4: explainability			.36	−0.911
Subgroup 1: previous use of AI	4 (4-5)	5		
Subgroup 2: no previous use of AI	4 (3.5-4.5)	4		
TC5: safety			.57	0.565
Subgroup 1: previous use of AI	5 (4-5)	5		
Subgroup 2: no previous use of AI	5 (4-5)	5		
TC6: fairness			.96	−0.048
Subgroup 1: previous use of AI	4 (4-5)	5		
Subgroup 2: no previous use of AI	4 (4-5)	5		
TC7: autonomy			.11	1.594
Subgroup 1: previous use of AI	4 (4-5)	5		
Subgroup 2: no previous use of AI	4 (4-5)	5		
TC8: responsibility			.22	−1.215
Subgroup 1: previous use of AI	5 (4-5)	5		
Subgroup 2: no previous use of AI	5 (4-5)	5		

Conclusions

This study provides a valuable understanding of the perceptions and experiences of medical students in Germany, Austria, and Switzerland regarding the application of AI in medicine, and its role in medical education. Our findings clearly indicate a discrepancy between students' interactions with AI-based chat applications such as ChatGPT and the representation of AI in their formal education. Despite a significant number of students interacting with AI technology, notably AI-based chat applications, only a fraction have received any formal AI education, revealing a substantial gap in the current medical curricula. This highlights the necessity of the evolution of medical curricula to incorporate AI and AI ethics education, ensuring that future medical professionals are adequately equipped to navigate the challenges and opportunities presented by AI in medicine.

Weidener & Fischer, 2024

Guirado et al., 2025

JMIR MEDICAL EDUCATION Weidener & Fischer

Original Paper

Artificial Intelligence Teaching as Part of Medical Education: Qualitative Analysis of Expert Interviews

Lukas Weidener, BSc, Dr med; Michael Fischer, PhD

Research Unit for Quality and Ethics in Health Care, UMIT TIROL – Private University for Health Sciences and Health Technology, Hall in Tirol, Austria

UMIT TIROL
THE TYROLEAN PRIVATE UNIVERSITY

INTEGRANDO INTELIGÊNCIAS NA GESTÃO DA SAÚDE
15-17 ABR | 2025
ROYAL PALM MALL, CAMPINAS (SP)

34º CONGRESSO FEHOSP
fehosp

Table 1. Overview of the 3 defined main categories with the associated 9 subcategories.

Main categories	Subcategories
Knowledge	• Basic understanding of artificial intelligence • Statistics • Ethics • Data protection and regulation
Interpretation	• Critical reflection • Associated risks • Data basis
Application	• Practical skills • Trust

As AI in medicine is likely to become increasingly significant in the future, medical users will need adequate knowledge and understanding to use it effectively. Due to the new opportunities and challenges associated with the use of AI-based applications in medicine, medical education needs to adapt to those changes, to provide future generations of physicians with the necessary knowledge and competencies. The research aims to emphasize the importance of integrating teaching content related to AI into the medical curriculum. The results provide implications for the creation of new teaching content based on interdisciplinary data collection. Furthermore, the results further imply a need for standardization in the definition of AI as a foundation for associated teaching content and the integration of AI into medical education. Subsequent research should explore the practical implications of this study and how the results can be transferred into the medical curriculum. Furthermore, research and the development of tools are needed to assess the current knowledge and competencies of medical students regarding the use of AI in medicine. This will not only have practical implications for the creation of new teaching content but will rather allow an assessment of the success of new teaching content in the future.

Weidener & Fischer, 2023

Guirado et al., 2025

Sumário

Guirado et al., 2025

- Riscos Clínicos:
  - Vieses algorítmicos e erros (diagnóstico/terapia) (Weidener & Fischer, 2024)
  - Comprometimento da segurança do paciente

- Riscos Relacionais e Éticos:
  - **Perda da confiança médico-paciente** (Funer et al., 2024)
  - **Desafios à autonomia (paciente e profissional)** (Weidener & Fischer, 2024; Funer et al., 2024).
  - **Dificuldades na responsabilização** (accountability) (Funer et al., 2024)

- Riscos Sistêmicos e de Gestão:
  - Aprofundamento de iniquidades em saúde (Weidener & Fischer, 2024)
  - Ineficiência e custos por má implementação
  - Impacto na reputação institucional

Sumário

Guirado et al., 2025

- O que médicos e gestores precisam saber e fazer?

  - ***Letramento em IA***: Entendimento básico de como funciona (sem precisar programar) (Weidener & Fischer, 2023)
  - ***Avaliação Crítica***: Capacidade de analisar resultados, identificar vieses e limitações (Weidener & Fischer, 2023; Funer et al., 2024)
  - ***Raciocínio Ético Aplicado***: **Habilidade de aplicar princípios éticos aos dilemas da IA** (Weidener & Fischer, 2023)
  - ***Comunicação Eficaz***: Explicar o uso da IA e seus resultados para pacientes e equipes (Funer et al., 2024)
  - ***Colaboração Interprofissional***: Integrar a IA no fluxo de trabalho da equipe (Weidener & Fischer, 2024)

Guirado et al., 2025

Sumário

Guirado et al., 2025

ORIGINAL RESEARCH

OPEN ACCESS

Coproduction of healthcare service

Maren Batalden,[1] Paul Batalden,[2] Peter Margolis,[3] Michael Seid,[3] Gail Armstrong,[4] Lisa Opipari-Arrigan,[3] Hans Hartung[5]

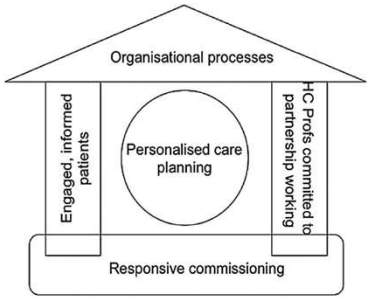


Figure 1 House of Care. Reproduced with permission of The King's Fund. Source: Coulter A, Roberts S, Dixon A (2013). Delivering better services for people with long-term conditions: building the house of care. London: The King's Fund. Available at: http://www.kingsfund.org.uk/publications/delivering-better-services-people-long-term-conditions

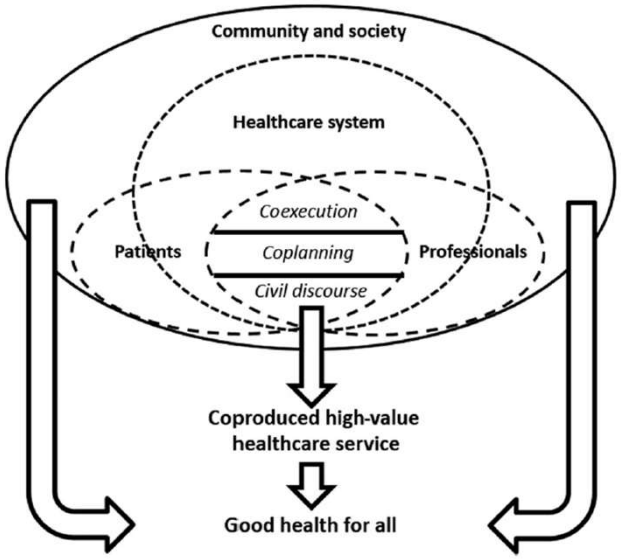


Figure 3 Conceptual model of healthcare service coproduction.

CONCLUSION

Healthcare is not a product manufactured by the healthcare system, but rather a service, which is cocreated by healthcare professionals in relationship with one another and with people seeking help to restore or maintain health for themselves and their families. This coproductive partnership is facilitated or hindered by many forces operating at the level of the healthcare system and the wider community. This frame has implications for understanding the aim of healthcare service and the potential roles and responsibilities of all participants. Improving healthcare service using this construct invites us to consider new ways of preparing health professionals and socialising patients, new organisational forms and structures for healthcare service delivery, and new metrics for measuring success. Like any paradigm, the construct of coproduced healthcare service is imperfect and contains its own pragmatic challenges and moral hazards, but these limitations do not negate its utility. Marcel Proust suggested that the real voyage of discovery consists not in seeking new landscapes, but in having new eyes.[63] Perhaps this lens of coproduction will help us see healthcare service with new eyes.

Batalden et al., 2016

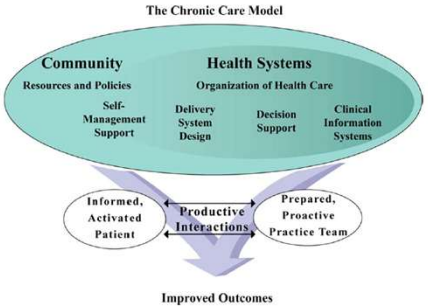


Figure 2 Chronic Care Model, developed by The MacColl Institute, © ACP-ASIM Journals and Books, reprinted with permission from ACP-ASIM Journals and Books. First published in: Wagner EH. Chronic disease management: what will it take to improve care for chronic illness? *Eff Clin Pract* 1998;1:2–4.

Guirado et al., 2025

Sumário

Desafios e Estratégias para o Setor Filantrópico

A Revolução da IA na Saúde

A Lacuna Educacional

Por Que se Preocupar?

Competências Essenciais para a Era da IA

Co-construção de soluções relevantes para o setor filantrópico

***Case In.Lab* - InovaHC - Hospital das Clínicas FMUSP**

Guirado et al., 2025

Sumário

- *Posicionamento estratégico*
- *Portifolio de projetos*
- *Tripla hélice*
- *Maturidade tecnológica*
- *Submissão de projetos*
- *Case: Projeto AIR - Brasil/Suécia*

In.lab

Laboratório de Inteligência Artificial

Centro de Pesquisa, Desenvolvimento e Inovação em Inteligência Artificial Aplicada à Saúde

Guirado et al., 2025

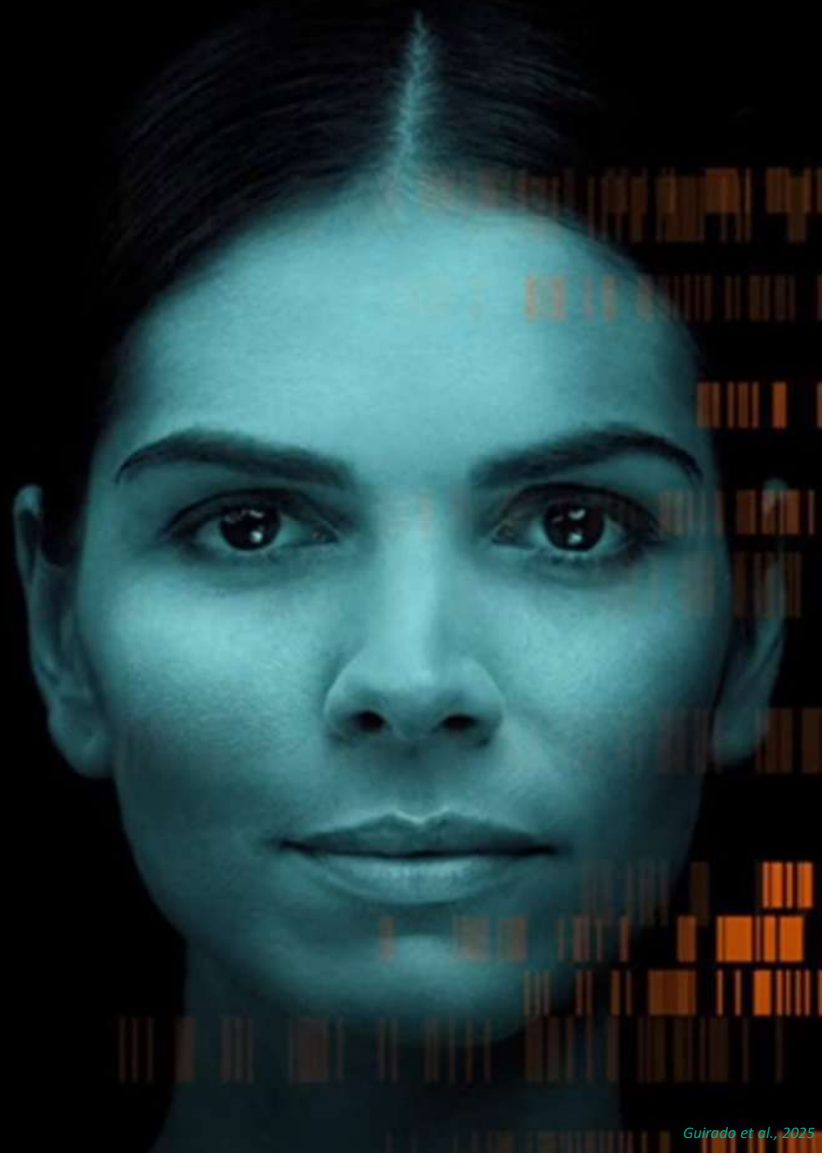
Inlab Team

Guirado et al., 2025

25 de Setembro de 2020

Inauguração

In.Lab



Guirado et al., 2025

Guirado et al., 2025

Guirado et al., 2025

CC&T

"Centro de Ciência, Tecnologia e Desenvolvimento para inovação em Medicina e Saúde: InLab Inova HC"

"Projeto de Pesquisa sobre sistemas integrados de informação em saúde, incluind grandes bases de dados, big data, inteligência artificial, modelos preditivos, tecnolog avançadas para diagnóstico, prevenção e tratamentos em Medicina"

Núcleo de Inovação Tecnológica, Inova HC
Hospital das Clínicas da Faculdade de Medicina da USP
Escola Politécnica de Engenharia da USP (POLI)

Pesquisador Responsável: Prof. Dr. Giovanni Guido Cerri
Professor Titular da Faculdade de Medicina da USP
https://bv.fapesp.br/pt/pesquisador/348/giovanni-guido-cerri/

Equipe Coordenação Geral

Giovanni Guido Cerri, Prof Titular FMUSP, Pesquisador Responsável (PR), Diretor Geral do Centro
Eduardo Mario Dias, Prof Titular, Escola Politécnica Engenharia USP, Pesquisador Principal #1
Claudia da Costa Leite, Professora Associada, FMUSP, Coord Educação, Pesquisadora #2
Marco Antonio Bego, Engenheiro, Diretor Executivo, Inrad e Inova HC
Vidal Augusto Zaparolli Melo, Coord Comunicação e Transferência Tecnologias, POLI USP
Marcio Biczyk, Coordenador CC&T InLab Inova HC, Hospital das Clínicas da Fac Medicina USP
Moacyr Martucci Junior, Escola Politécnica Engenharia USP, Pesquisador Associado
Umberto Tachinardi, Pesquisador, Universidade de Indiana, Indianapolis, USA

São Paulo

Centro de Ciência, Tecnologia e Inovação

01/06/2022 a 31/05/2027

Guirado et al., 2025

Sumário

- ***Posicionamento estratégico***
- *Portifolio de projetos*
- *Tripla hélice*
- *Maturidade tecnológica*
- *Submissão de projetos*
- *Case: Projeto AIR - Brasil/Suécia*

Posicionamento estratégico

O In.lab é um Centro de Pesquisa, Desenvolvimento e Inovação em Inteligência Artificial Aplicada à Saúde

Missão

Promover a saúde e o bem estar social por meio da pesquisa, desenvolvimento, inovação e capacitação profissional em tecnologias aplicadas à área da saúde

Visão

Ser o principal centro de Pesquisa, Desenvolvimento e Inovação (PD&I) de tecnologias voltadas à saúde da América Latina até 2028

Valores

Centrados no paciente, ética, confiança, trabalho em equipe, transparência e inovação

Guirado et al., 2025

APOIO TÉCNICO-CIENTÍFICO E CONEXÕES

Apoio técnico-científico ao desenvolvimento de projetos e soluções tecnológicas para a saúde

INTELIGÊNCIA DE DADOS

Mineração de dados de saúde com clareza, eficiência e segurança

INTEGRAÇÃO CLÍNICA E VALIDAÇÃO

Garantir que as soluções propostas sejam utilizadas e validadas na prática clínica

CODESENVOLVIMENTO DE SOLUÇÕES

Codesenvolvimento de produtos e soluções tecnológicas para a área da saúde

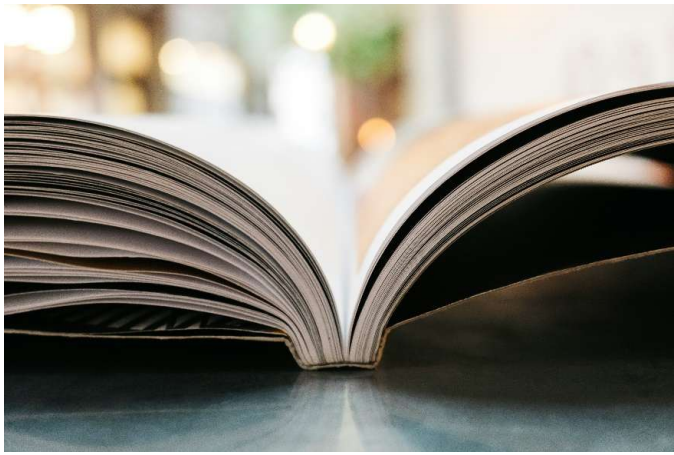
Guirado et al., 2025

Sumário

- *Posicionamento estratégico*
- ***Portifolio de projetos***
- *Tripla hélice*
- *Maturidade tecnológica*
- *Submissão de projetos*
- *Case: Projeto AIR - Brasil/Suécia*

Guirado et al., 2025

1. MRI Ressonância Magnética 7-Tesla (Siemens)
2. Análise imagens Rx e Tomografia para detecção Covid-19 (Siemens)
3. Rastreamento epidemiológico por NLP (linguagem natural)
4. Predição de risco cirúrgico para pacientes (Neo de Pulmão)
5. Screening de Mamografias para análise de Ca Mama
6. Aprendizado Federado distribuído, análise Rx idade óssea (Siemens)
7. Diagnóstico de lesões hepáticas (Tomografia Abdominal)
8. Marketplace de soluções de IA em Medicina (Huawei)
9. Centro de Ciência CC&T fapesp: Poli-USP, Unicamp, Unifesp, MIT, IPT, UC, ...
10. Desenvolvimento e capacitação em Inteligência Artificial (Philips)
11. Automated Radiological Report Generation for X-Rays (AGFA-Vizio) / new
12. Multimodal Analysis Clinical Data AI-ML Diagnosis (AWS Amazon) / new
13. Chat GPD visual, desenvolvimento plataforma IA em Radiologia / new
14. “The Radiologist” plataform using IA: Rx, CT, USG, MMG, MRI / new
15. Quantificação doenças pulmonares em CT tórax / (Siemens) / new
16. ...



Guirado et al., 2025

Sumário

- *Posicionamento estratégico*
- *Portifolio de projetos*
- ***Tripla hélice***
- *Maturidade tecnológica*
- *Submissão de projetos*
- *Case: Projeto AIR - Brasil/Suécia*

Guirado et al., 2025


Guirado et al., 2025

Theme paper Triple Helix I (January 1995)

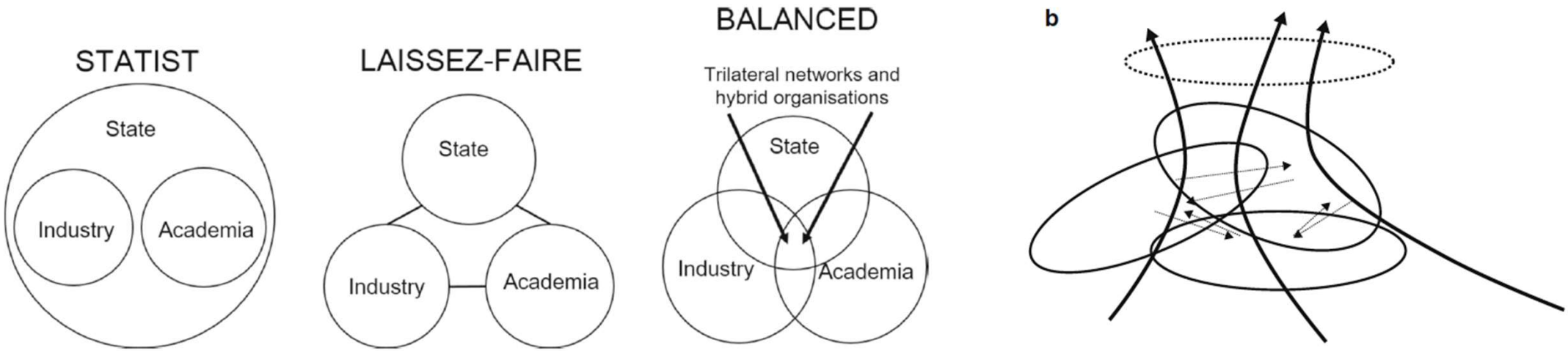
THE TRIPLE HELIX---UNIVERSITY-INDUSTRY-GOVERNMENT RELATIONS: A LABORATORY FOR KNOWLEDGE BASED ECONOMIC DEVELOPMENT

EASST Review 14 (1995, nr. 1) 14-19.

Henry Etzkowitz, Sociology, State University of New York at Purchase and Science Policy Institute (SPI) SUNY Stony Brook

Loet Leydesdorff, Science & Technology Dynamics, University of Amsterdam

Etzkowitz H, Leydesdorff L. The Triple Helix -- University-Industry-Government Relations: A Laboratory for Knowledge Based Economic Development. EASST Review 1995;14(1):14-19.



Etzkowitz & Levdesdorff, 1995

Guirado et al., 2025

Sumário

- *Posicionamento estratégico*
- *Portifolio de projetos*
- *Tripla hélice*
- ***Maturidade tecnológica***
- *Submissão de projetos*
- *Case: Projeto AIR - Brasil/Suécia*

Guirado et al., 2025

JOURNAL OF THE INTERNATIONAL ASTRONAUTICAL FEDERATION
ASTRONAUTICA ACTA

Acta Astronautica Vol. 20, pp. 73–77, 1989
Printed in Great Britain

0094-5765/89 $3.00 + 0.00
Pergamon Press plc

THE NASA TECHNOLOGY PUSH TOWARDS FUTURE SPACE MISSION SYSTEMS

Stanley R. Sadin, Frederick P. Povinelli, Robert Rosen
NASA Headquarters, OAST

Sadin SR, Povinelli FP, Rosen R. The NASA technology push towards future space mission systems. Acta Astronaut 1989;20:73-77.

ABSTRACT

As a result of the new Space Policy, the NASA technology program has been called upon to a provide a solid base of national capabilities and talent to serve NASA's civil space program, commercial, and other space sector interests. This paper describes the new technology program structure and its characteristics, traces its origin and evolution, and projects the likely near- and far- term strategic steps. It addresses the alternative "push-pull" approaches to technology development, the readiness levels to which the technology needs to be developed for effective technology transfer, and the focused technology programs currently being implemented to satisfy the needs of future space systems.

LEVEL 1 - BASIC PRINCIPLES OBSERVED AND REPORTED

LEVEL 2 - POTENTIAL APPLICATION VALIDATED

LEVEL 3 - PROOF-OF-CONCEPT DEMONSTRATED, ANALYTICALLY AND/OR EXPERIMENTALLY

LEVEL 4 - COMPONENT AND/OR BREADBOARD LABORATORY VALIDATED

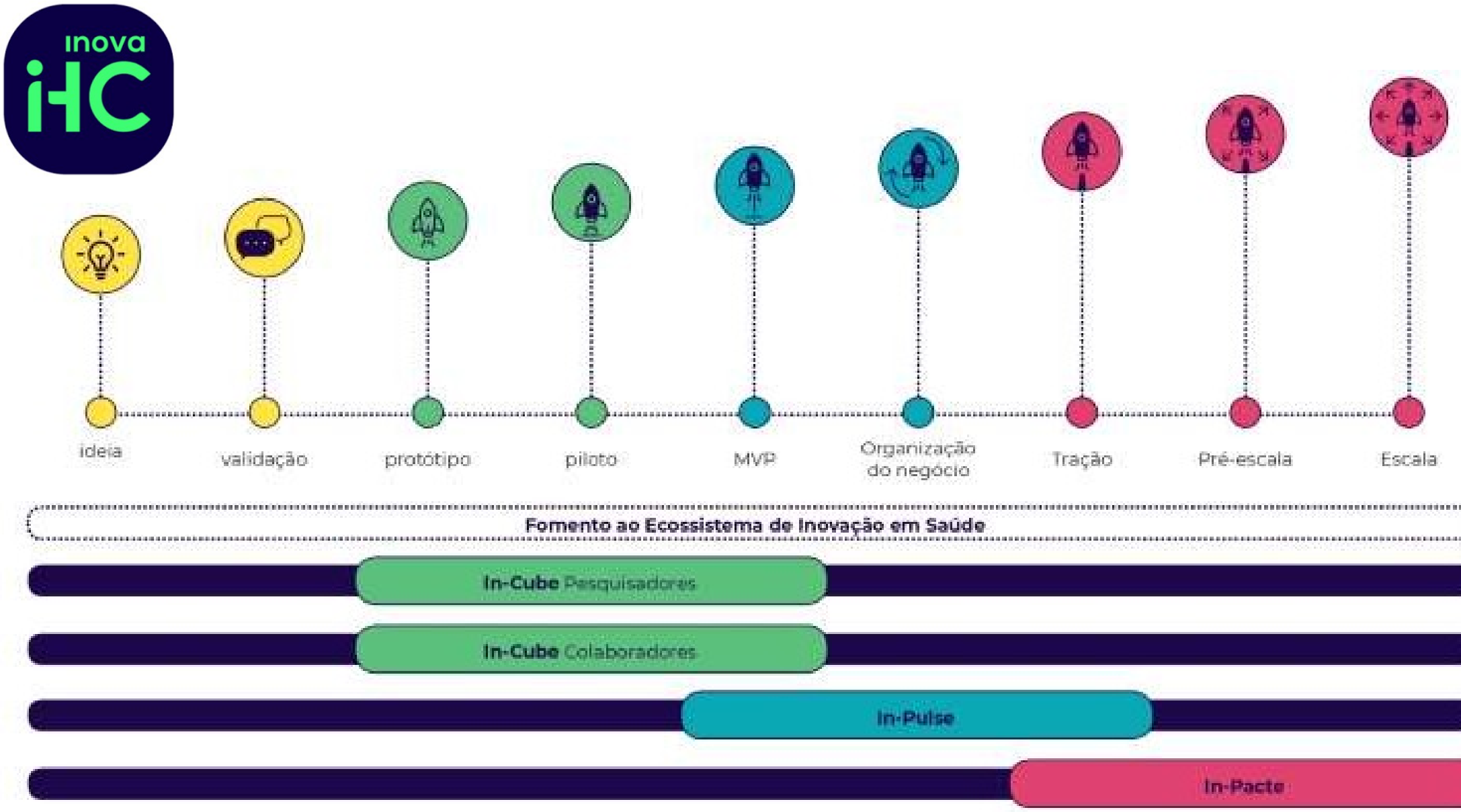
LEVEL 5 - COMPONENT AND/OR BREADBOARD VALIDATED IN SIMULATED OR REAL-SPACE ENVIRONMENT

LEVEL 6 - SYSTEM ADEQUACY VALIDATED IN SIMULATED ENVIRONMENT

LEVEL 7 - SYSTEM ADEQUACY VALIDATED IN SPACE

Sadin, Povinelli & Rosen, 1989

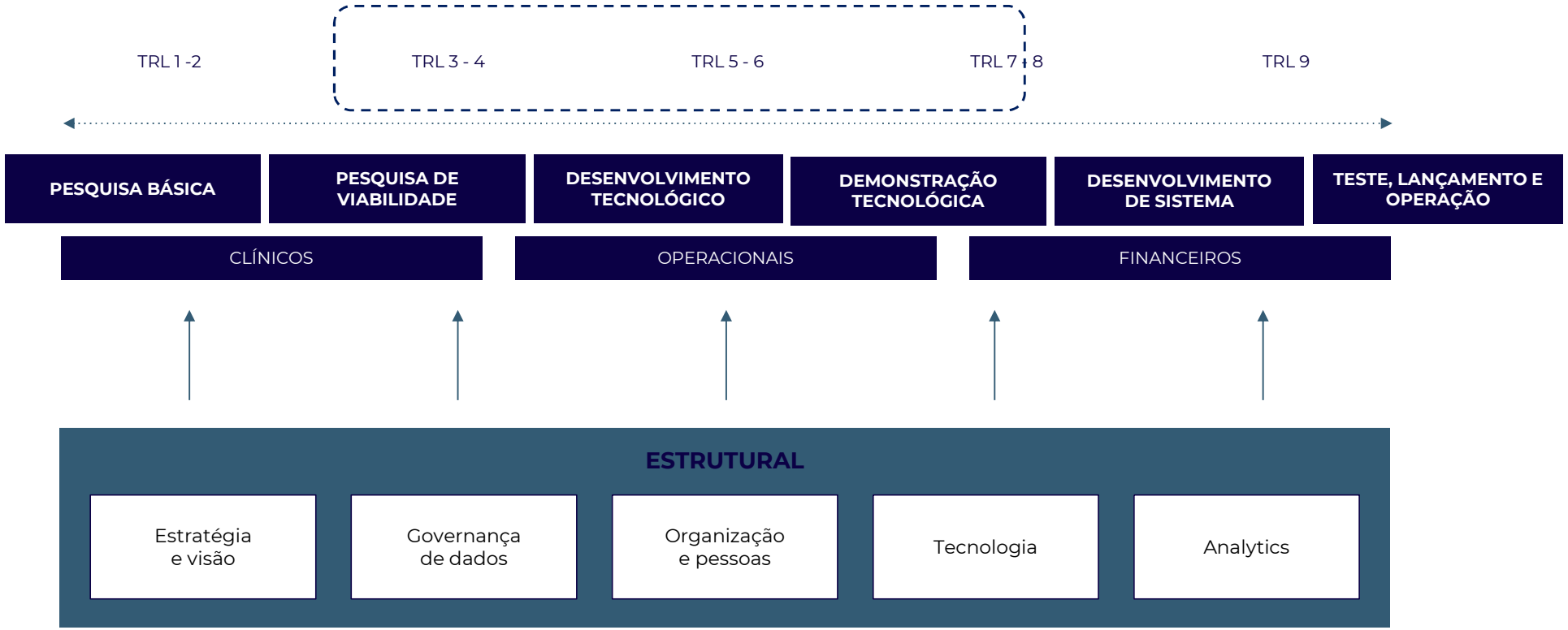
Guirado et al., 2025



Guirado et al., 2025

NÍVEIS DE MATURIDADE

para o desenvolvimento de projetos



Guirado et al., 2025

Sumário

- *Posicionamento estratégico*
- *Portifolio de projetos*
- *Tripla hélice*
- *Maturidade tecnológica*
- ***Submissão de projetos***
- *Case: Projeto AIR - Brasil/Suécia*

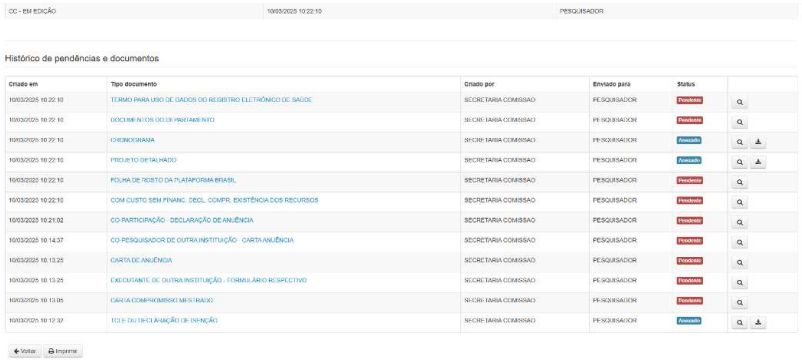
Guirado et al., 2025

Hospital das Clínicas da FMUSP
Comissão de Ética para Análise de Projetos de Pesquisa **CAPPesq**

AGENDA DE REUNIÕES - 2025

MÊS	DIA
JANEIRO	15
FEVEREIRO	05 19
MARÇO	12 26
ABRIL	09 23
MAIO	07 21
JUNHO	04 18
JULHO	02 23
AGOSTO	06 20
SETEMBRO	03 17
OUTUBRO	08 29
NOVEMBRO	12 26
DEZEMBRO	17

As reuniões são realizadas no 5º andar do Prédio da Administração – Sala do Conselho Deliberativo - Horário: 9h.



Núcleo Especializado em Tecnologia de Informação - NETI

O NETI é o Núcleo Especializado em Tecnologia da Informação do Hospital das Clínicas da Faculdade de Medicina da USP.

Diagnóstico Integrado de Inteligência Artificial (IA)			
Projeto piloto de manifestação de interesse baseado nas necessidades do negócio			
Você quer se envolver no desenvolvimento de uma ferramenta de IA que seja adquirida, avaliada e implementada em nossa vida clínica diária?			
Se sim, responda as perguntas e envie para o coordenador abaixo. Fique à vontade para entrar em contato caso tenha dúvidas!			
1	Título do projeto		
2	Responsável pelo projeto	Pessoa de contato	
		Celular	
		E-mail	
		Conexão clínica com o projeto	
		Serviço/Localização	
		contato clínico sobre fluxo de pacientes:	
		Gerente de operações	
3	Problema clínico	Problemas que o projeto pretende resolver com a ajuda da IA	
4	Impacto clínico	Estimativa do efeito nos cuidados de saúde no Brasil (economia financeira, melhoria da qualidade, melhoria da eficiência)	
5	Grau de maturidade clínica	Os dados estão disponíveis? Existe um conjunto de dados anotado [ausente, iniciado, finalizado]	
		Possível parceiro de colaboração	
6	Parcerias	Aberto a parceiros externos (circule sim ou não)	
		sim (pode ser sujeito a concurso público)	
		não (vinculado a parceiro externo com quem já existe colaboração)	
7	Projeto de pesquisa clínica	Pesquisa em andamento na área (se sim - de quem é a Propriedade Intelectual?, Colaboradores?)	
8	Viabilidade clínica de mundo real	Viabilidade (juntamente com o parceiro de inovação certo - você estima que dois anos são suficientes para a implementação?)	
Coordenação: In.Lab CCT InovaHC		Responsável Técnico: Márcio Biczyk do Amaral	
		Responsável Clínico: Vinícius Monteiro de Paula Guirado	

Guirado et al., 2025

Sumário

- *Posicionamento estratégico*
- *Portifolio de projetos*
- *Tripla hélice*
- *Maturidade tecnológica*
- *Submissão de projetos*
- ***Case: Projeto AIR - Brasil/Suécia***

Guirado et al., 2025

In.lab

Collaborative projects to generate sustainable solutions to both market and society, with the potential of addressing societal challenges.

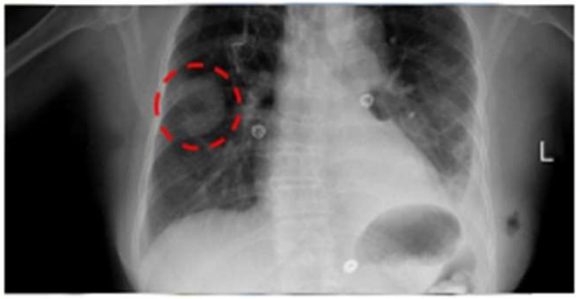
HALMSTAD UNIVERSITY

Guirado et al., 2025







A creative and multidisciplinary project

AIR - A co-pilot tool for quantitative assessment of lung diseases

hh.se

HALMSTAD UNIVERSITY

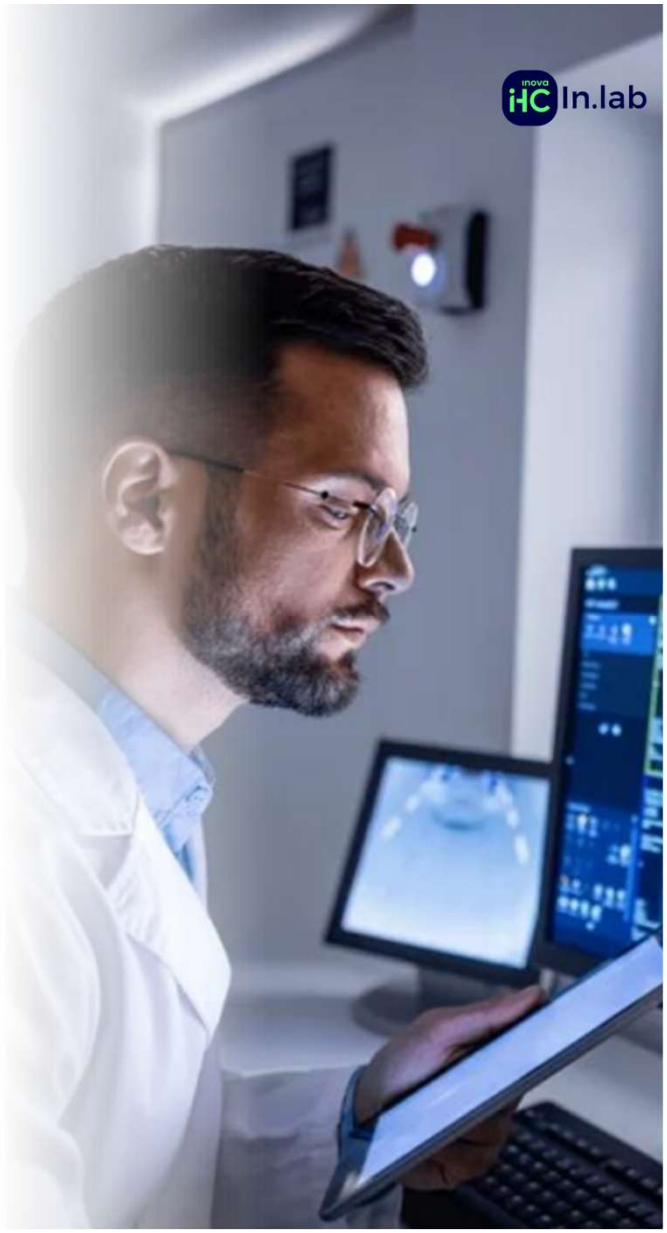
Guirado et al., 2025

Applications of AI in Pulmonology: AI is utilized for automated detection of lung nodules, analysis of lung tissue, detection of pulmonary embolism, and predictive analyses.

Limitations: Although these AI solutions are promising, they are less effective in monitoring chronic lung diseases, formulating treatment plans, and conducting follow-ups.

Reliance on Subjective Analysis: Present methodologies largely depend on the subjective, qualitative assessment of imaging and biomarkers, which hinge on the expertise of radiologists.

Challenges in Remote Areas: In nations like Brazil and Sweden, where geographical distances are vast and many live far from medical facilities, the reliance on subjective interpretation of CT scans and frequent blood sampling for lung health poses significant challenges for patient care.



Guirado et al., 2025

Project objectives

1st – AIR aims to develop an AI tool that enables objective and reproducible quantification of predominant lung disease such as Interstitial Lung Disease.

2nd – AIR seeks to support radiologists in accurately diagnosing and managing lung diseases over time.

3rd – AIR aims to drive international collaboration that holds market potential and addresses societal challenges by evaluating the impact of biomarker data collection through self sampling in remote areas.

Guirado et al., 2025

Project partners

certi

PHILIPS Healthcare

inovaIHC In.lab

Capitainer

HALMSTAD UNIVERSITY

Guirado et al., 2025

Fábio Gama

Research

- AI project management (AIR project)
- Trustworthy AI systems (Development and implementation)
  - AIGENT (AI QIF) – Framework to guide the implementation of AI in healthcare
  - Trustworthy principles conflicts and overlaps (explainability vs performance)
  - Explainable LLMs (AI for patient journals evaluation aiming resources management)
  - AI Sandbox Ethics

Education

- Halmstad University (MSc and PhD courses)
- UDESC /ESAG – University of the State of Santa Catarina (MSc and PhD courses)
- USP / Poli – University of São Paulo (MSc and PhD courses)

Sumário

In.Lab

- *Posicionamento estratégico*
- *Portifolio de projetos*
- *Tripla hélice*
- *Maturidade tecnológica*
- *Submissão de projetos*
- *Case: Projeto AIR - Brasil/Suécia*

Guirado et al., 2025

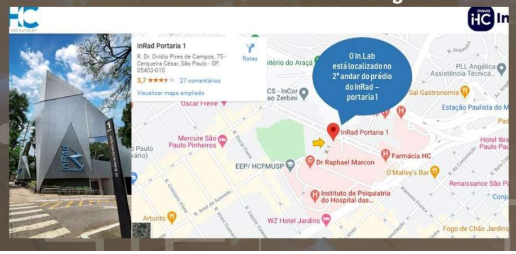
Você Conhece o In.lab?

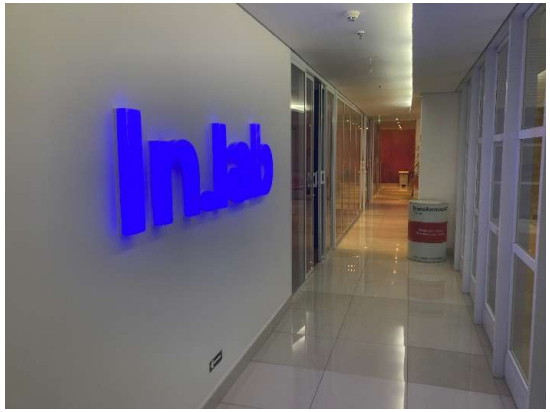
O IN.LAB É UM CENTRO DE PESQUISA, DESENVOLVIMENTO E INOVACÃO EM INTELIGÊNCIA ARTIFICIAL APLICADA À SAÚDE DO HCMUSP.

O Laboratório iniciou suas atividades há 3 anos com o objetivo criar soluções através da Tecnologia buscando conexões entre pesquisadores, profissionais e jornada do paciente no HCFMUSP, através de projetos inovadores .

Venha nos visitar

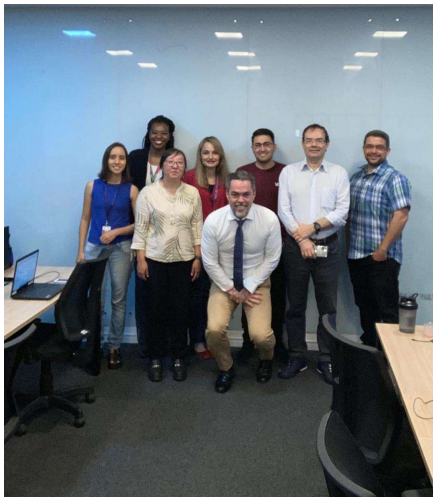
O In.lab fica no 2º Andar do Instituto de Radiologia do HCFMUSP

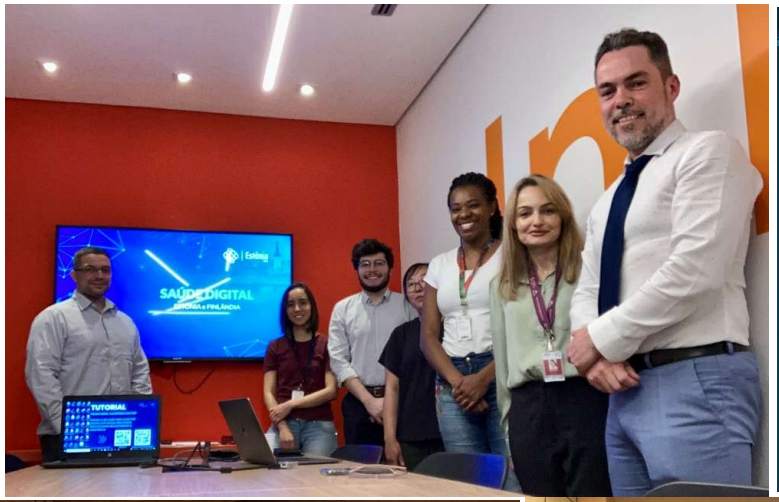




Guirado et al., 2025

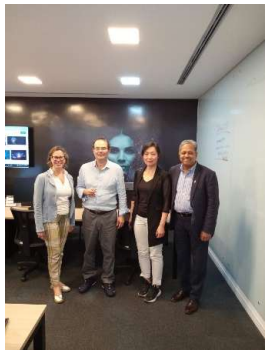

TUTORIAL




SAÚDE DIGITAL
TUTORIAL


Fmusp
in.lab
InRad
CURSO
INTELIGÊNCIA ARTIFICIAL APLICADA À SAÚDE - CONCEITOS E APLICAÇÕES
É com imensa satisfação que convidamos você a participar de um curso para explorar e aprofundar seus conhecimentos sobre Inteligência Artificial na área da saúde.
O curso foi concebido para profissionais da área da saúde e gestores que desejam aprender sobre a IA com profundidade, mas que não se interessam por conceitos matemáticos complexos ou por aprender a programar computadores.
Explore como a IA promete humanizar e potencializar os cuidados na saúde e aprenda a integrar e liderar equipes multidisciplinares para aplicação da tecnologia na resolução de problemas.
Você foi uma das 20 pessoas escolhidas para fazer parte deste curso.
É necessário que você confirme sua participação. Para isso, basta responder a este e-mail.
Dia 08/12 (sexta-feira)
Horário: das 8h às 14h.
InRad - Auditório 2


Cases AI healthcare
Center for Applied Intelligent Systems Research (CAISR) health

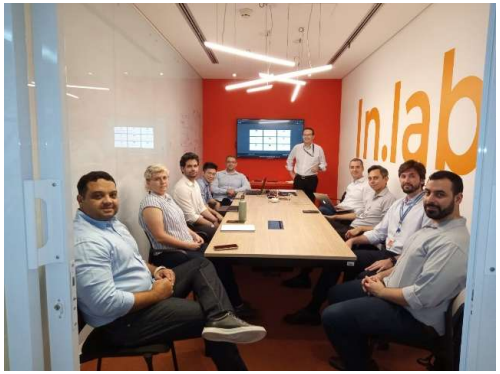


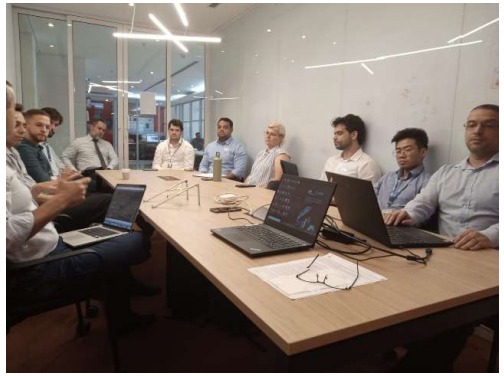

InRad
in.lab











Guirado et al., 2025

Sumário - Conclusões

Desafios e Estratégias para o Setor Filantrópico	**Governança**
A Revolução da IA na Saúde	**Transformação**
A Lacuna Educacional	**Desafio**
Por Que se Preocupar?	**Educação**
Competências Essenciais para a Era da IA	**Ética**
Co-construções de soluções relevantes para o setor filantrópico	**Colaboração**
Case In.Lab - InovaHC - Hospital das Clínicas FMUSP	**Inovação**

Guirado et al., 2025

“De longe, o maior perigo da Inteligência Artificial é que as pessoas concluam muito cedo que a entendem.”

Guirado et al., 2025

Obrigado

vinicius.guirado@hc.fm.usp.br

www.viniciusguirado.com.br