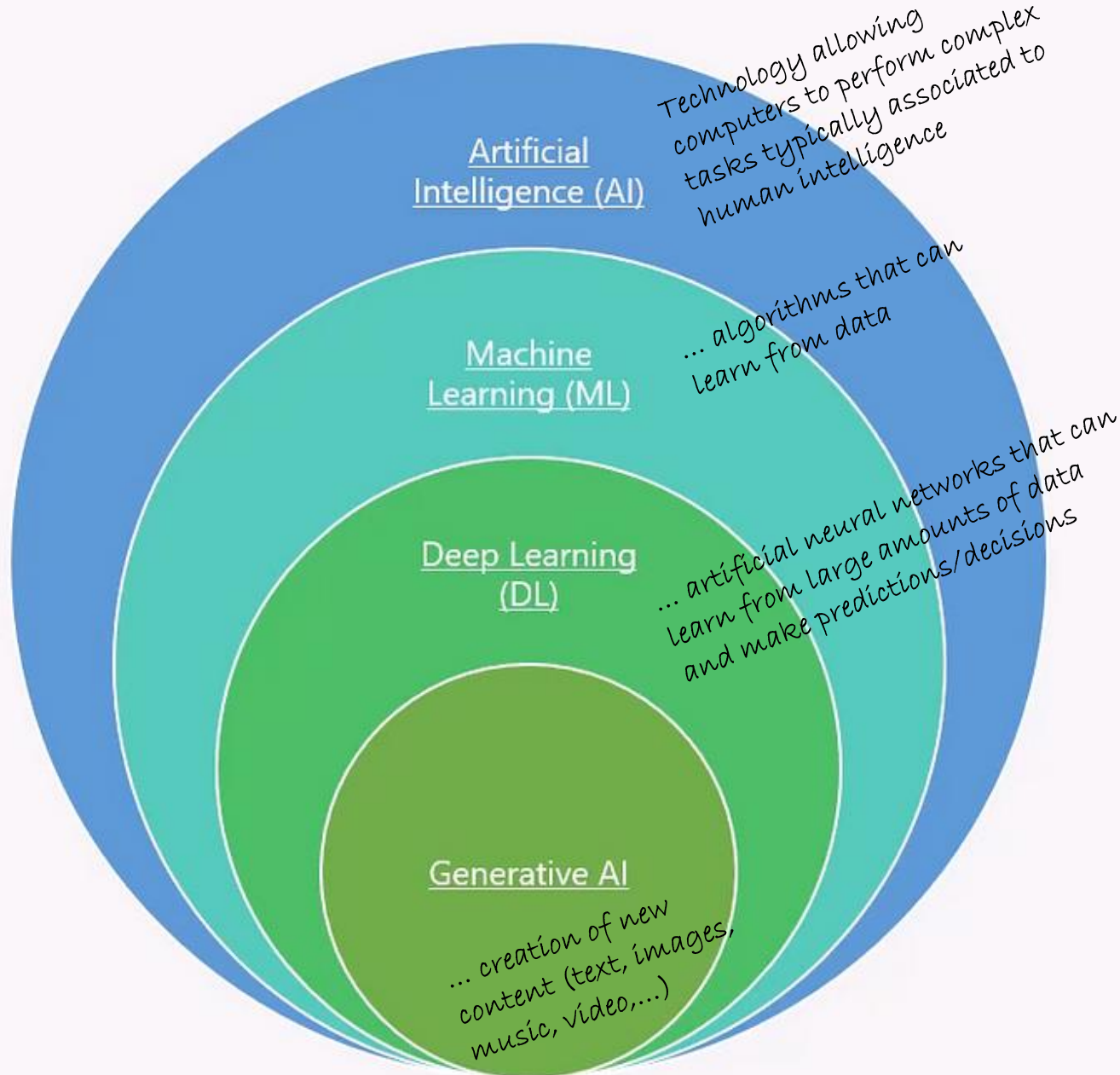# Harnessing the Power of Data & AI to Improve Healthcare for All:
Are We Up to the Challenge?

Guadalupe Bedoya, DEC Development Impact, World Bank
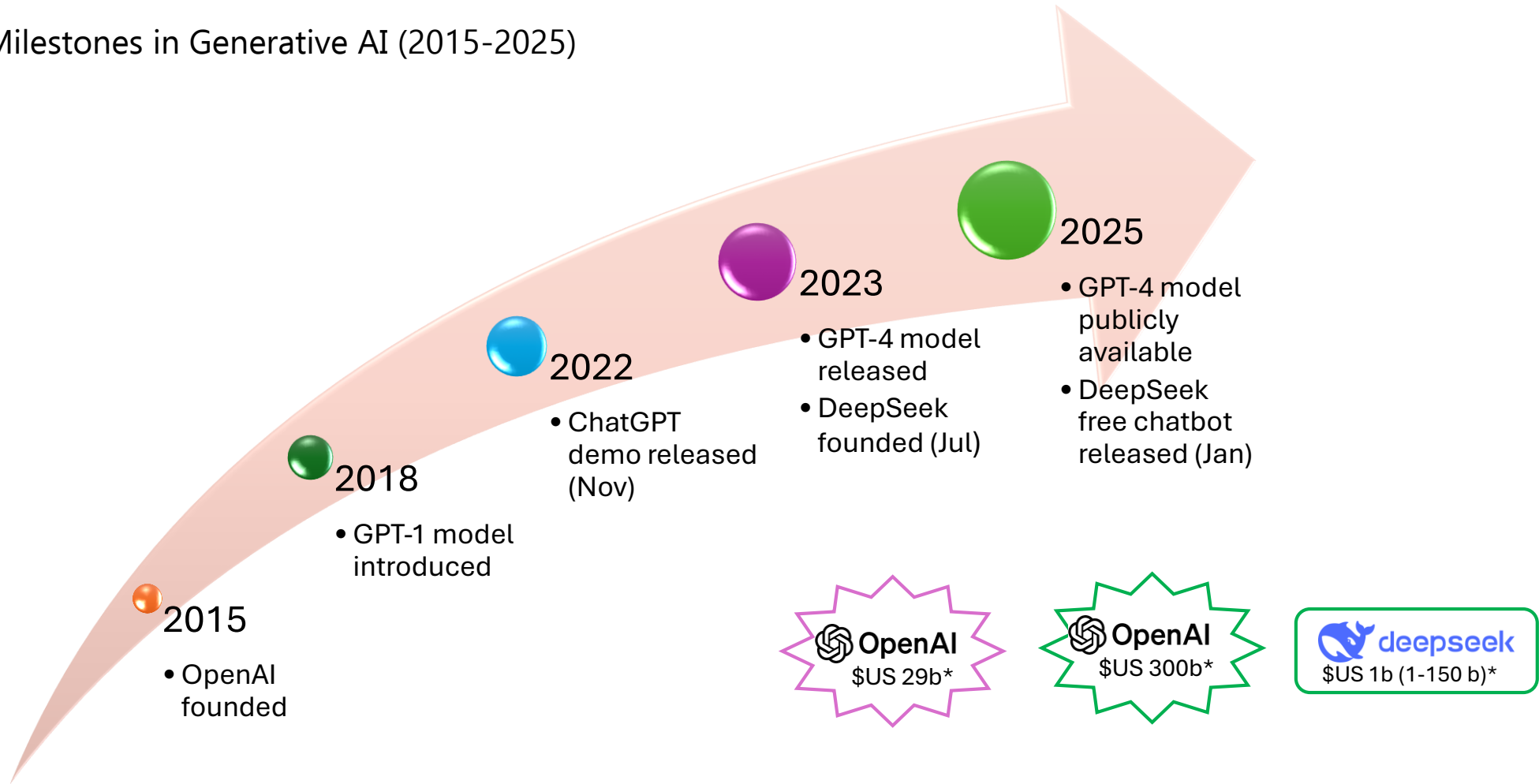
May 22, 2025

European Commission

WORLD BANK GROUP

The AI Family Tree: From AI to Generative AI

Artificial Intelligence (AI) — Technology allowing computers to perform complex tasks typically associated to human intelligence

Machine Learning (ML) — ... algorithms that can learn from data

Deep Learning (DL) — ... artificial neural networks that can learn from large amounts of data and make predictions/decisions

Generative AI — ... creation of new content (text, images, music, video,...)

Sources: Figure Navneet Singh, definitions based on Google AI

Rapid advances in Artificial Intelligence (AI) technologies promise to transform the health sector...

AI's (market) value is growing rapidly...
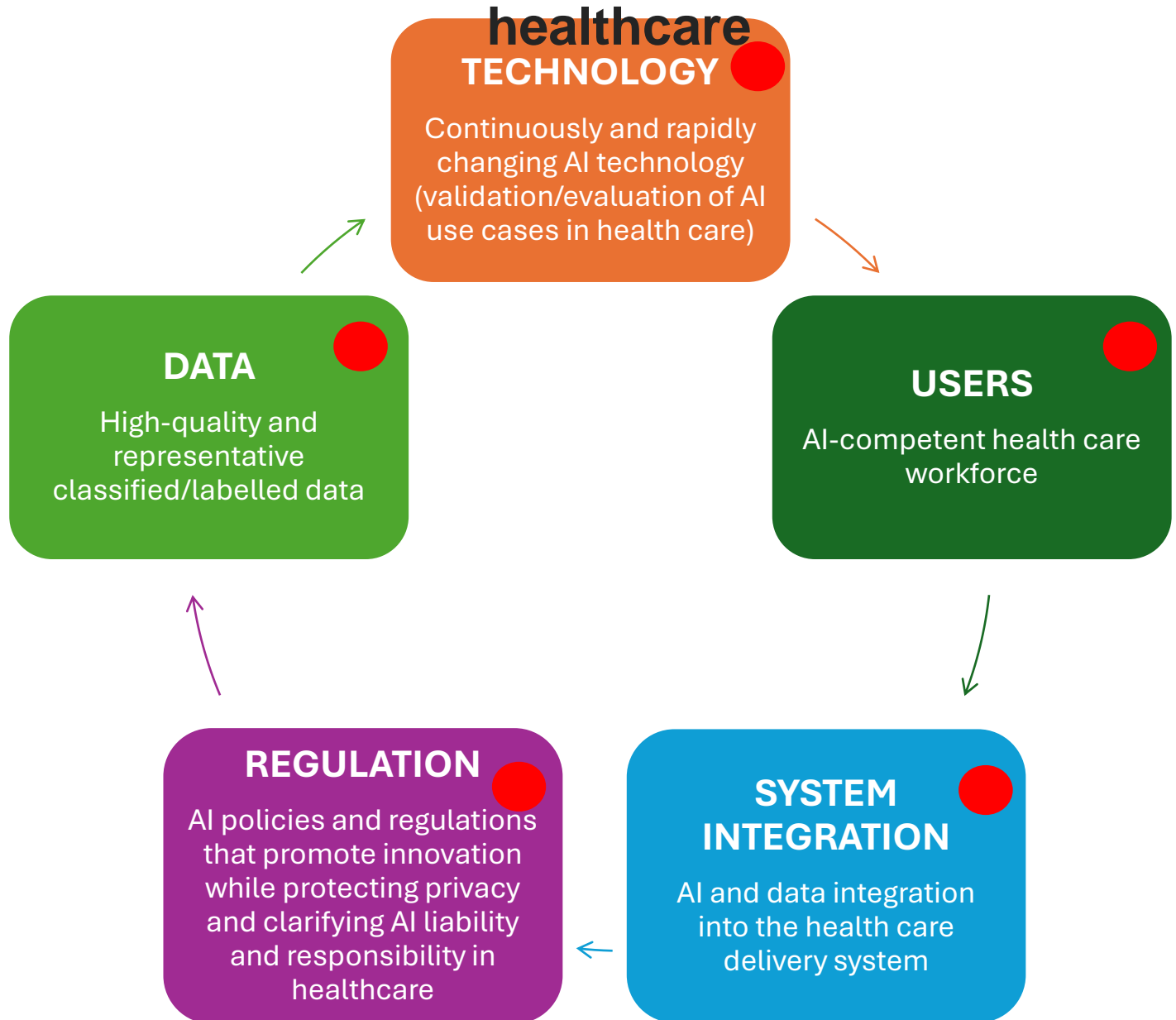
Select Milestones in Generative AI (2015-2025)

2025
- GPT-4 model publicly available
- DeepSeek free chatbot released (Jan)

2023
- GPT-4 model released
- DeepSeek founded (Jul)

2022
- ChatGPT demo released (Nov)

2018
- GPT-1 model introduced

2015
- OpenAI founded

OpenAI
$US 29b*

OpenAI
$US 300b*

deepseek
$US 1b (1-150 b)*

Estimates from various sources. None of these firms are publicly traded on any stock market yet but OpenAI, for instance, has Pre-IPO valuations.

Enablers/deterrents of the use of AI to improve healthcare

But AI's <u>impact in health care practice has been limited</u> so far, compared to its promise

Significant role for governments!

TECHNOLOGY
Continuously and rapidly changing AI technology (validation/evaluation of AI use cases in health care)

DATA
High-quality and representative classified/labelled data

USERS
AI-competent health care workforce

SYSTEM INTEGRATION
AI and data integration into the health care delivery system

REGULATION
AI policies and regulations that promote innovation while protecting privacy and clarifying AI liability and responsibility in healthcare

Sources: Adjusted based on Matheny et al. (2025), and various sources

Some illustrations of AI advances and potential in health...

AI & Diagnostic Imaging
Potential: Improving accuracy and efficiency in diagnosis

- **Facts/Problem**
  - Traditional methods of image interpretation can be time-consuming and subject to human error

- **Example AI-based tools to help address the problem**
  - Brain AI algorithm to automate segmentation, labeling and quantification for more than 100 volume measurements.
  - AI CT image reconstruction algorithm that can enhance imaging quality, reduce noise and reduce radiation dose.

Select Challenges
- Data/algorithm biases
- Data privacy
- Data quality/quantity

Example of an AI CT image reconstruction algorithm that can enhance imaging quality, reduce noise and reduce radiation dose. This is Canon's second-generation reconstruction AI, which was gained FDA in March 2024.

AI Vuno Med Deep AI algorithm in October 2023 by the FDA. Photo by Dave Fornell at RSNA 2023.

One of the most mature areas with proven impacts

- Image analysis and interpretation
- Operational efficiency
- Predictive and personalized healthcare
- Clinical decision support

Sources: Kahlifa et al. (2024), FDA approved algorithms.

AI & & medical decision support: knowledge spread

Potential: Improved decision-making at point of care

Select Challenges
- Data/algorithm biases
- Trust
- Liability
- Data quality/quantity

- **Facts/problem**
  - Medical knowledge doubles every 5 years.
  - At least 1 new medical paper published every minute.
  - Practitioners unable to keep up with medical knowledge

- **Example AI-based tool to help address the problem**
  - **OpenEvidence**, an AI-powered search engine that **synthesizes evidence from peer-reviewed studies** in real time for **improved decisions at point of care.**
  - About 30% of doctors use it in the U.S.
  - Spain, Italy and the United Kingdom among users it in Europe
  - $US 1b valuation in early 2025

OpenEvid
Clinical Decis
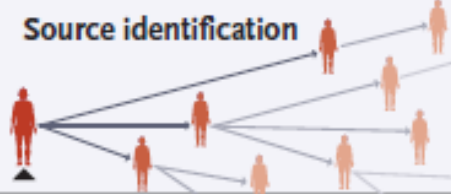OpenEvidenc

#31 in Medical
★★★★★ 4.9 • 2.6K R

Free

AI & Infections-Disease Surveillance

Potential: Improved and timely health emergency identification, tracking and response everywhere (reduction of mortality, morbidity and related costs)

**Improving cost-effectiveness
- risk-based decision-making
- identification of pathogens**

Sources: Brownstein et al. (2023);Tornimbene et al. (2025)

Function	Examples
Early warning	• Natural-language processing of news sourc[es] (Freifeld et al., *JAMIA* 2008) • Unsupervised machine learning of social m[edia] infections (Lim, Tucker, and Kumara, *J Biom[ed]*)
Pathogen classification	• Convolutional neural network model for rea[l] *Nat Commun* 2021) • Convolutional neural network model to auto[mate] diagnosis (Liang et al., *IEEE* 2016)
Risk assessment	• Reinforcement learning of Covid-19 positivity rates to target limited testing in Greece (Bastani et al., *Nature* 2021) • Machine-learning models including random forest and extreme gradient boosting to use syndromic surveillance for Covid-19 risk prediction (Dantas, *PLoS One* 2021)
Source identification	• Automated data mining of electronic medical records to uncover hidden routes of infection transmission (Sundermann et al., *Clin Infect Dis* 2021) • Supervised machine learning in combination with digital signal processing for genomic tracing of Covid-19 (Randhawa et al., *PLoS One* 2020)
Hotspot detection	• Neural computing engine to correlate sound from hospital waiting rooms with influenza spikes (Al Hossain et al., *Proc ACM Interact Mob Wearable Ubiquitous Technol* 2020) • Multilayer perceptron artificial neural network model to detect spatial clustering of tuberculosis (Mollalo et al., *Int J Environ Res Public Health* 2019)
Tracking and forecasting	• Real-time stacking of multiple models to improve forecasts of seasonal influenza (Reich et al., *PLoS Comput Biol* 2019) • Machine learning to combine new data sources for monitoring Covid-19 (Liu et al., *J Med Internet Res* 2020)

Select Challenges
- Data/algorithm biases
- Data privacy
- Data quality/quantity

AI & medical decision support
Potential: Improved decision-making at point of care

- **Fact/problem**
  - Lack of adequate quantity and quality of healthcare workers
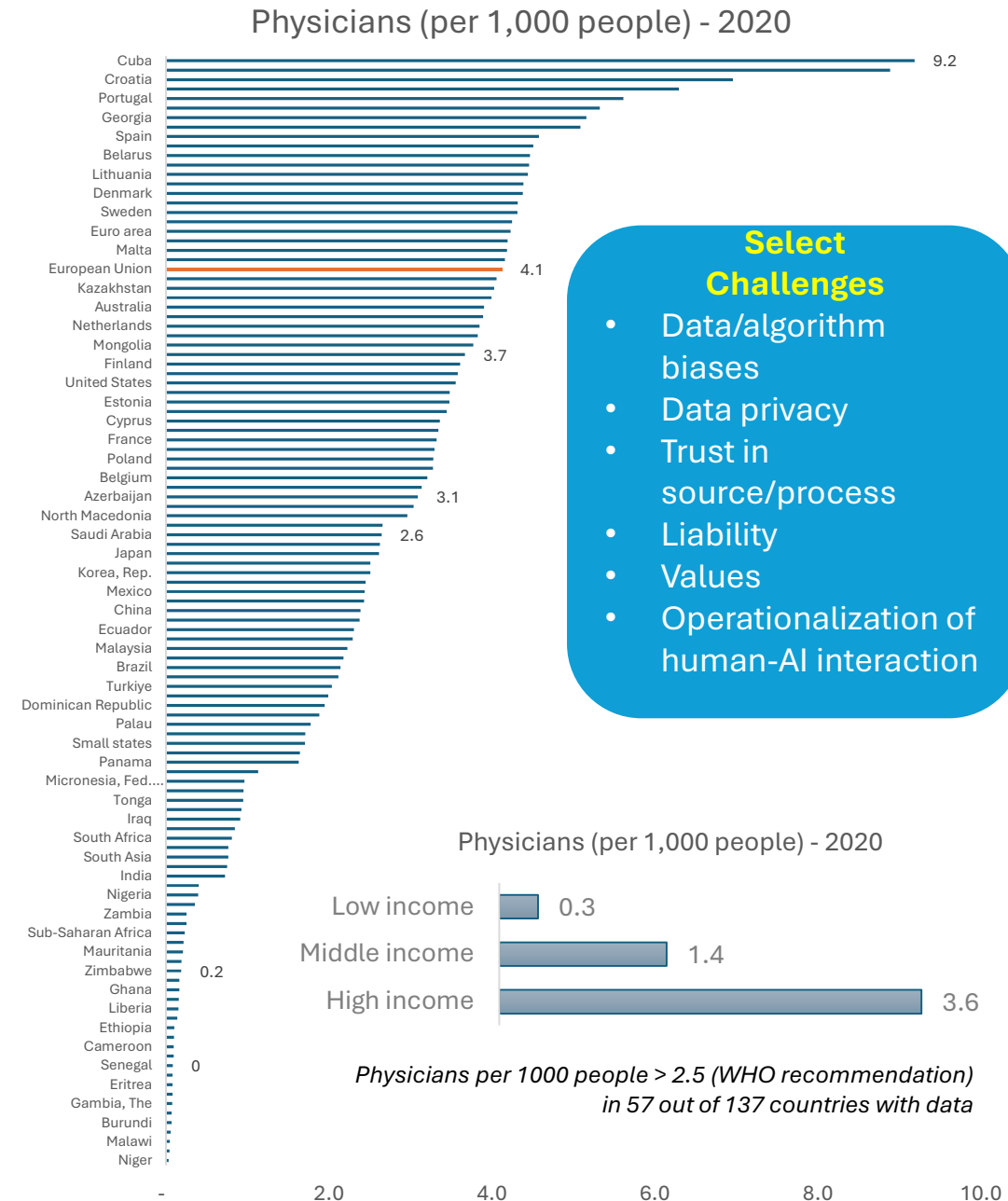 - Practitioners unable to keep up with medical knowledge and apply it in practice

- **Example GenAI-based tools to help address the problem**
  - Many based on general purpose models (e.g., ChatGPT, Gemini, Llama, Claude)

> This is a more difficult problem
> - Medicine is not an exact science
> - Diverse quality of sources
> - Different values change the output (e.g., patient, insurer)
> - Input is not always adequate/complete (bigger problem in low-resource settings)

- **Performance:** <u>**Insufficient evaluation**</u> but from a <u>2025 meta-analysis</u> (83 studies, most on ChatGPT versions), in terms of diagnostic performance:
  - GenAI models overall accuracy = 52%
  - GenAI models are no better/worse than non-expert physicians
  - GenAI models are worse than expert physicians

Physicians (per 1,000 people) - 2020

Select Challenges
- Data/algorithm biases
- Data privacy
- Trust in source/process
- Liability
- Values
- Operationalization of human-AI interaction

Physicians (per 1,000 people) - 2020

Low income	0.3
Middle income	1.4
High income	3.6

Physicians per 1000 people > 2.5 (WHO recommendation) in 57 out of 137 countries with data

Two examples of the potential of data integration and AI in health…

Data integration and AI in health in Colombia

TicSocial

Private firm facilitating the use of technology to improve efficiency/outcomes of high-risk patients (e.g., cancer, diabetes)
Clients: Insurers, hospitals, pharmaceutical companies | 40% of Colombia population's records, 25% of cancer patients

Colombia has almost universal healthcare insurance coverage (96 - 99%),* has significant health data but lacks adequate systems that integrate patients' data for public health purposes
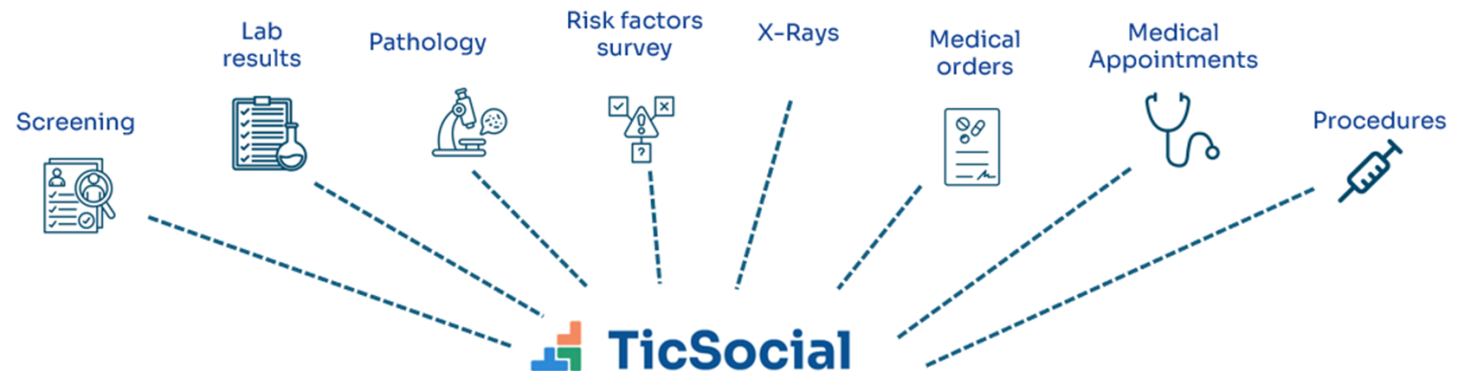
Colombia

Late diagnosis and delayed treatment

Scattered patient data

Lack of coordination across different actors/departments

Lack of risk-based screening

Screening | Lab results | Pathology | Risk factors survey | X-Rays | Medical orders | Medical Appointments | Procedures

TicSocial

Increased efficiency and resource allocation

Increased early detection

Decreased time to treatment

Better patient outcomes / cost savings

Data integration & AI for knowledge in Colombia

Posso et al. integrate national **health care data, vital statistics, physicians' education and demographic data** and find...

Physician MD-exit exam score (quality)

One SD.   ● Mean
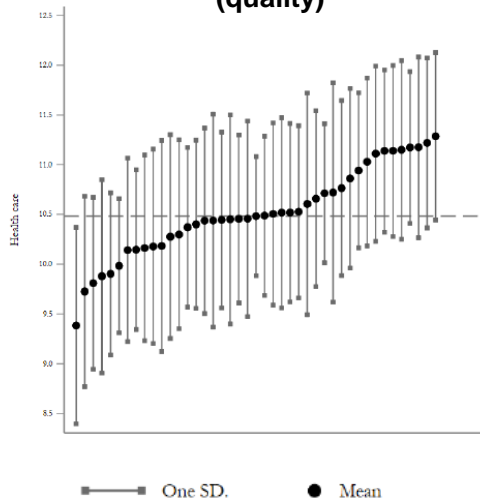
- A higher quality physician (1 SD => 11.5 vs 10.5 score) reduces the probability of being born unhealthy by 8-9%

- Mechanism: Higher-quality physicians can more effectively target care for at-risk mothers (AI=>ML)

Potential policy follow-ups
- Can we predict ex-ante high-risk mothers and test interventions in low-resource areas (data integration + AI + experimentation)?
- Can we test other interventions to improve the worst-performing areas?

Depression, treatment and labor outcomes

Danesh et al. integrate **health care data (all population)** and **labor data (formal sector)** and find...
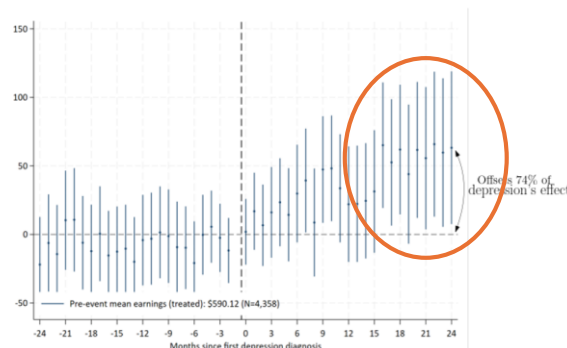
Income trajectory and depression event
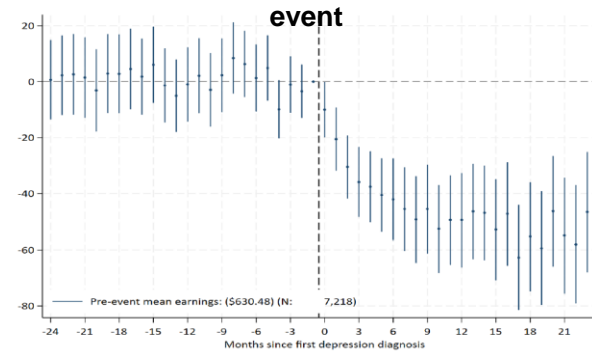
Income drops significantly after a depression episode and the fall is persistent

✓ **Treatment, mostly therapy, offsets 74% of the fall in income**
✓ **The fall in income persists for the untreated group**

Income trajectory with treatment

Potential policy follow-ups
- Can treatment variations increase income faster or be more cost-effective?
- Can we predict / prevent depression episodes?

Data integration and AI in health in **Israel**

Clalit Health Services, a non-profit healthcare insurance and service provider (covers 52% of the population)
Clalit Research Institute's mission is turning data into actionable insights for healthcare policy and clinical practice
Clalit Innovation aims at translating data and knowledge into innovative solutions and digital health tools to enhance healthcare delivery

AI & Data to shift traditional, reactive medicine towards proactive, predictive and personalized care, which is at the frontier

Israel has universal healthcare coverage.

Clalit's data→ 20 years of medical history
- Diagnoses
- Hospitalizations
- Clinic visits
- Demographic and personal markers
- Labs
- Medications
- Medical procedures, and
- Special registries.

Developed data infrastructure/platforms/ processes to leverage these

Predictive medicine	• Predictive models to detect early signs of disease and track health outcomes. • Example: Hepatitis C machine-learning based screening (100-fold-greater efficiency than international guidelines)
Precision Medicine	• Working on personalized care based on genetic, biological and personal characteristics of patients and their disease (consent) • Genomic center, biobank, living lab, precision medicine imitative
AI & Behavioral Insights	• Patients' behavioral profiling based on their data → patients' health-seeking behavior, preferences and needs • Tailor care strategies

Three Takeaways

1. **Data integration and AI in health have great potential to benefit patients by helping address current weaknesses in healthcare systems**
   - Improving quality and efficiency
   - Improving preventive and personalized medicine
   - Reducing medical errors
   - Reducing inequalities in access to (quality) healthcare

2. **In many settings, significant benefits can be realized with the current data and technology, but it will require investments and continuous adaptation**
   - Data infrastructure
   - Data integration
   - Data-and-AI-competent workforce
   - State-of-the-art "AI toolkit" - Simple AI tools could go a long way for many problems

3. **There is considerable work needed from governments, researchers and stakeholders on the use cases of AI in health that reflect patient-centered values and limit inappropriate/unethical uses.**
   - Increasing evaluation/auditing of AI technologies
   - Producing timely regulation and guidelines

"It is no longer a conversation about, 'Will AI replace doctors,' so much as, 'Will AI, with a set of clinicians who may not look like the clinicians that we're used to, firm up the tottering edifice that is organized medicine?'"

Isaac Kohane, chairman of Harvard Medical School's Department of Biomedical Informatics and editor-in-chief of the New England Journal of Medicine's new AI journal, March 2025