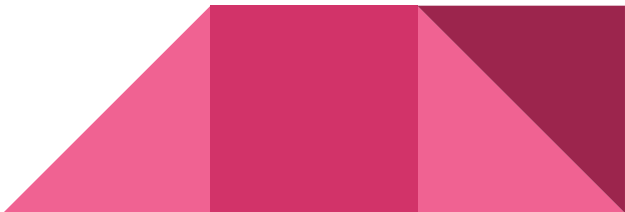# AI in Public Health: The Roles of Awareness, Understanding, and Trust

Lisa Gualtieri, PhD, ScM

Email: lgualtieri@hsph.harvard.edu

MHOA, November 13, 2024

Agenda

- Introduction
- AI in Public Health Associations
- AI in Global, National, State, and Local Public Health
- Some Success Stories
- Awareness, Understanding, and Trust in AI
- How Can AI Help You?

Have you heard of? (left hand)
Have you used? (right hand)

- ChatGPT
- Gemini
- Large Language Models (LLMs)
- Natural Language Processing (NLP)
- Machine Learning (ML)

Definitions

- **ChatGPT** is a conversational AI model developed by OpenAI. It's designed to generate human-like text responses based on the input it receives.
- **Gemini** is an AI project developed by Google as their foundational AI model.
- **Large language model (LLM):** ChatGPT and Gemini are examples of LLMs that are essentially AI chatbots optimized for human-like dialog.
- **Natural Language Processing (NLP):** An area of AI focused on the interaction between computers and humans through natural language, enabling machines to understand, interpret, and generate human language.
- **Machine Learning (ML) is a** subset of AI focused on the development of algorithms that allow computers to learn and make decisions from data.
- **Computer Vision** enables machines to process and analyze visual information.
- **Robotics**: AI-powered robots to perform intricate tasks.
- **Artificial intelligence (AI)** is the term used to describe the use of computers and technology to **simulate intelligent behavior and critical thinking comparable to a human being** or **perform tasks that are usually undertaken by humans.**

Are You Using and Don't Know It?

- **Email spam filters**: Uses Natural Language Processing (NLP) and Machine Learning (ML) to analyze email content and sender behavior.
- **Credit card fraud detection**: Uses neural networks and anomaly detection models to flag potential fraud and identify unusual transaction activities.
- **Customer service bots**: Interactive Voice Systems (IVS) uses AI to answer queries and process requests.
- **Netflix recommendation systems**: AI models "learn" user tastes and recommend movies, adapting recommendations over time.
- **Navigation systems**: Google Maps and Waze use AI for route optimizations, traffic predictions, and real-time navigation.

The Turing Test (Alan Turing)

The **Turing Test*** is the ultimate test for discerning if AI or human

Remember this if you ever scream, "You're so stupid" at an AI application

*More than 70 years after Turing's proposal, AI has not passed the test by fulfilling the specific conditions Turing outlined, but a few systems have come close

More AI Integrated into Everything
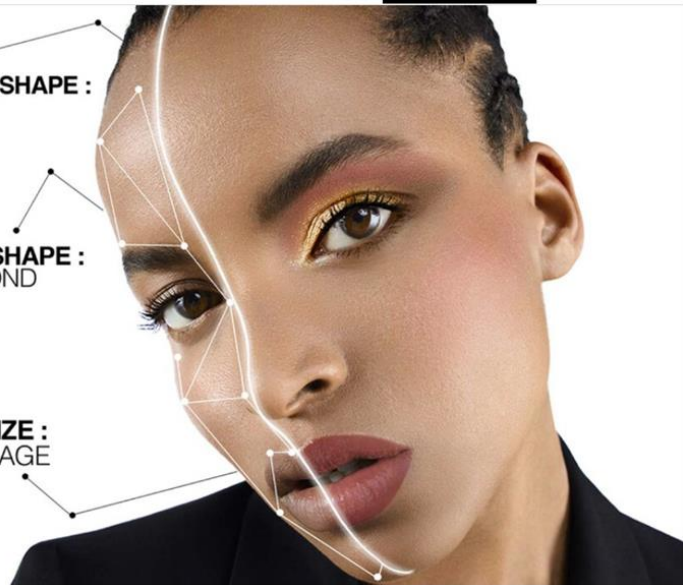
Our Interest Is
in AI in
Healthcare
and Medicine:
2 papers
under review

Patient Perspectives on Artificial Intelligence in Medical Imaging

Jeffry Glenning[1] BS; Lisa Gualtieri[1] PhD

[1]Cedars-Sinai Los Angeles US

Corresponding Author:
Jeffry Glenning BS
Cedars-Sinai
8700 Beverly Blvd
Los Angeles
US

Abstract

The integration of artificial intelligence (AI) into medical imaging has the potential to improve diagnostic accuracy, efficiency, and patient outcomes. However, its successful adoption may depend not only on technological advancements but also on how AI is perceived and understood by patients. This paper explores patient perspectives on AI in medical imaging, with a focus on trust, human interaction, and ethical considerations such as data privacy and accountability. Studies suggest that while some patients recognize AI's potential to enhance diagnostic processes, others are concerned about losing the empathy and nuanced judgment of clinicians. Concerns about bias in AI, particularly for underrepresented patient populations, and the financial implications of adopting these technologies also emerge as key issues. The paper proposes that increasing transparency about AI use in diagnostics—such as informing patients when AI has contributed to their care—could help address these concerns. Additionally, offering patients more information and choice regarding the AI tools used in their diagnostic processes may foster greater trust. A patient-centered approach that considers these perspectives may help guide the responsible integration of AI in medical imaging. N/A N/A N/A N/A N/A

Patient Awareness, Understanding, and Trust in AI
Journal of Participatory Medicine
Paper under review

Patient Awareness, Understanding, and Trust in AI

Lisa Gualtieri PhD, ScM; Yolanda Sutherland[1] MPH

[1]Tufts University School of Medicine Boston US

Corresponding Author:
Lisa Gualtieri PhD, ScM

Abstract

With artificial intelligence (AI) playing an increasingly prominent role in healthcare, patients are arguably the most impacted. For patients to be empowered in the many ways in which AI impacts their care, rather than remaining passive recipients, they need awareness, understanding, and trust in AI. We evaluate the current state of AI in healthcare from the all-important patient perspective, and consider future directions supporting a more equitable future with enhanced care for the wide variety of patient needs.
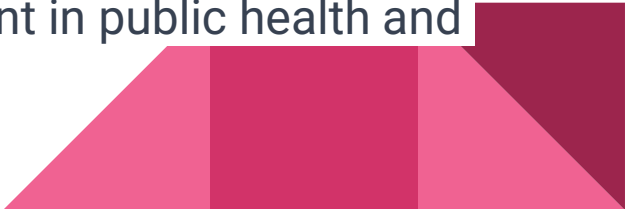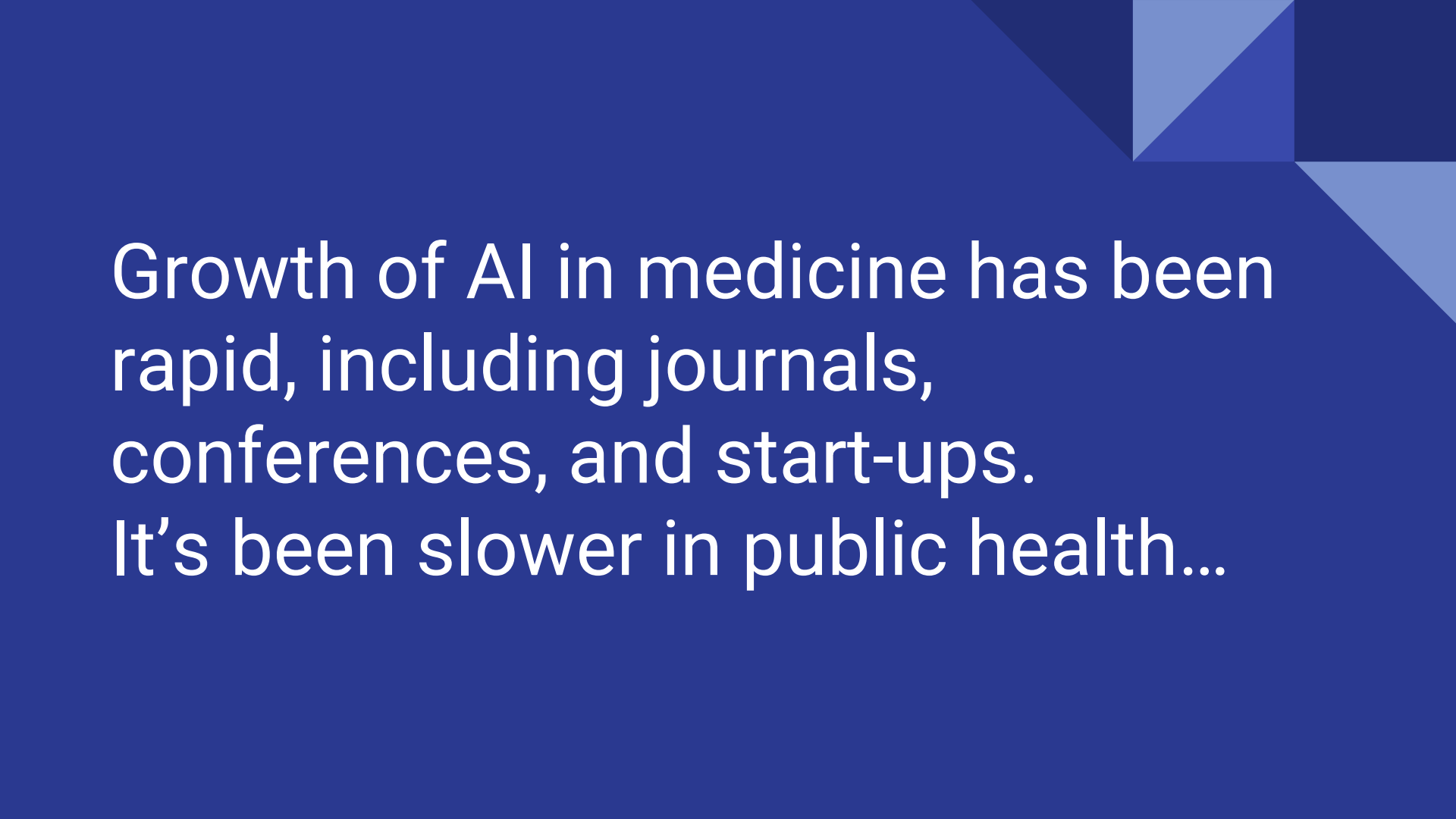
Our Focus Is on How Patients are Impacted By AI, and How to Promote Health Equity and Address Bias

- AI can exacerbate or shrink the health disparity gap.
- Concerns about AI biases focus on algorithm flaws, external biases, experience, exclusion, environment, empathy, and evidence.
- Solutions include forming diverse teams, including data from underrepresented demographic groups in datasets, and designing AI technologies for all users to access.
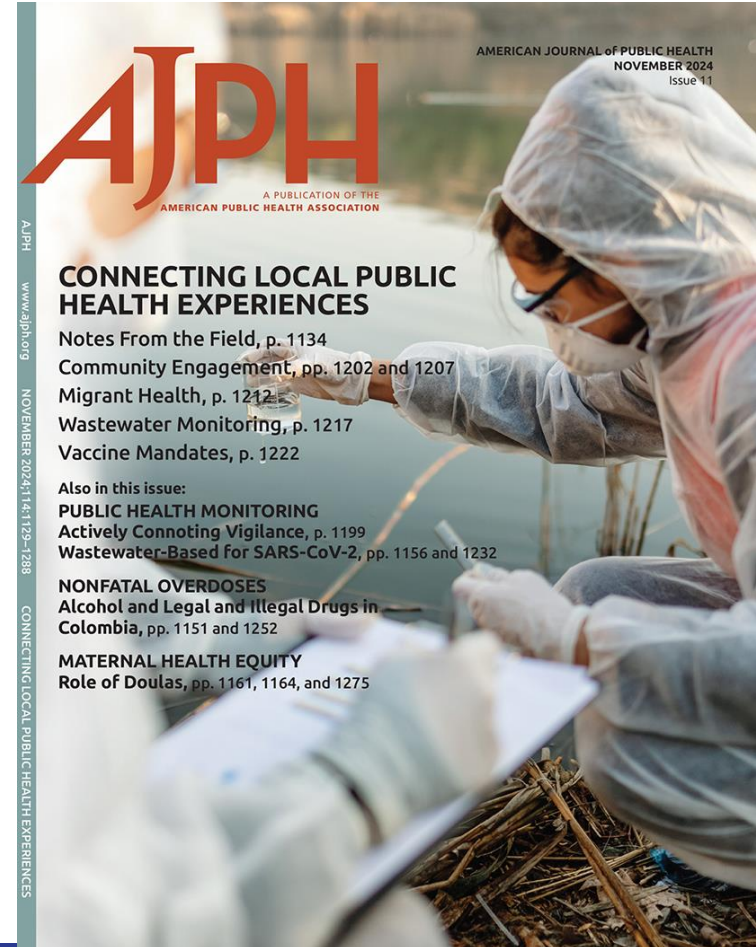- Important for all applications of AI but most important in public health and medicine.

Growth of AI in medicine has been rapid, including journals, conferences, and start-ups.
It's been slower in public health…

AI in Professional Public Health Organizations - APHA

American Journal of Public Health (AJPH)

- Only 4 out of ~50,000 articles published since 1911 have "Artificial Intelligence" in the title.

https://ajph.aphapublications.org/

AMERICAN JOURNAL of PUBLIC HEALTH
NOVEMBER 2024
Issue 11

AJPH

A PUBLICATION OF THE
AMERICAN PUBLIC HEALTH ASSOCIATION

CONNECTING LOCAL PUBLIC HEALTH EXPERIENCES

Notes From the Field, p. 1134
Community Engagement, pp. 1202 and 1207
Migrant Health, p. 1212
Wastewater Monitoring, p. 1217
Vaccine Mandates, p. 1222

Also in this issue:
PUBLIC HEALTH MONITORING
Actively Connoting Vigilance, p. 1199
Wastewater-Based for SARS-CoV-2, pp. 1156 and 1232

NONFATAL OVERDOSES
Alcohol and Legal and Illegal Drugs in Colombia, pp. 1151 and 1252

MATERNAL HEALTH EQUITY
Role of Doulas, pp. 1161, 1164, and 1275

AJPH www.ajph.org

NOVEMBER 2024/114/1129–1288

CONNECTING LOCAL PUBLIC HEALTH EXPERIENCES

AI at APHA 2024

OpenAI GPT-4o ⌄

LG **Lisa Gualtieri**

How many sessions at APHA 2024 had AI in the title

‹ 1 / 2 › 🔊 ✏️ ⧉ ⅃

GPT-4o

I currently don't have access to real-time data or databases to provide updates on specific events like the APHA 2024 conference. To find out how many sessions had "AI" in the title, you would need to consult the official program or schedule for APHA 2024, typically available on their website or through contacting the event organizers directly.

🔊 ✏️ ⧉ ⟳ ⅃

APHA 2024
ANNUAL MEETING & EXPO
Minneapolis | Oct. 27-30

3.5% of APHA 2024 sessions/posters had AI in the title

- My colleague Si Pearman reported that there were 23 sessions/posters with AI in the title
- He further reported, "There are approximately 75 sessions each time there is a major time block, and there are 4 times blocks on Monday/Tuesday so that is 600 sessions, and then there are about 25 sessions on Sunday afternoon and 25 on Wednesday morning so around 650 total simultaneous sessions.

How many presentations are there on AI at MHOA?

AI in Global Public Health

World Health Organization (WHO) primary interest is in monitoring disease spread and response

- Traditional Approach: Manual data collection, slower outbreak detection.
- AI Approach: Real-time analysis and NLP for faster, accurate monitoring.
- Why: To improve outbreak response and data accuracy.
- Outcome: Quicker global health tracking and responses.

Link to Resource: Harnessing AI for Health

"AI is already playing a role in diagnosis and clinical care, drug development, disease surveillance, outbreak response, and health systems management ... The future of healthcare is digital, and we must do what we can to promote universal access to these innovations and prevent them from becoming another driver for inequity. "

Tedros Adhanom Ghebreyesus
WHO Director-General

AI at the World Health Organization (WHO)

AI at the Centers for Disease Control and Prevention (CDC)

To date:

- **Improve speed and accuracy in surveillance** by [automatically detecting tuberculosis](#) ↗ from chest X-rays
- **Accelerate outbreak response** to Legionnaires' disease and prevent future disease by [automatically detecting cooling towers](#) ↗ from aerial imagery
- **Enhance COVID-19 vaccine safety monitoring** by using natural language processing (NLP) methods to analyze massive amounts of free text for [potential safety signals](#)
- **Use more of the data we have:**
  - Identify opioid-related terms on death certificates, even if they're misspelled
  - Impute missing data from surveys, or fix sparsity in geographical sampling
- **Use non-traditional data sources**, including images, audio, social media, and data not specifically collected for public health analysis, such as electronic health records
- **Be more mindful of potential disparities** by evaluating fairness and mitigating bias in machine learning and other data-analytic methods
- **Optimize case definitions** for more accurate and [efficient surveillance](#) ↗
- **Discover patterns in clinical data** and **identify predictors** for clinical outcomes

AI at the Centers for Disease Control and Prevention (CDC)

What's next:
- Use of NLP methods on foodborne outbreak data to identify potential outbreak sources.
- Automation in cause-of-death coding, remote disease detection, and predictive modeling to speed up data processing, boost accuracy, and detect health risks efficiently.
  - Traditional: Manual mortality coding, field inspections for Legionella, and traditional statistical models.
  - AI: Automated coding with MedCoder, remote Legionella detection via TowerScout, and ML for opioid mortality prediction.
  - Outcome: Early results show better coding accuracy and timely risk identification, benefiting high-risk areas.

AI at MA DPH

Massachusetts Department of Public Health
Commissioner Robert Goldstein, MD, PhD

We Keep People Healthy and Communities Strong

We make it safe to eat and drink in Massachusetts.

Inspected **2,000** food manufacturing facilities and supported local boards of health inspecting **40,000** food outlets

Investigated more than **900** cases of food-borne illness and more than **70** outbreaks

Evaluated the health risks of PFAS contamination – from swimming, eating fish, and drinking water in Massachusetts communities

We ensure that your environment is healthy and safe.

Investigated **6,000** homes for lead paint and helped over **450** families eliminate the risk of lead poisoning for children

With local health, tested over **16,000** water samples at **1,100** beaches

Safety inspected over **1,000** X-ray, laser and mammography machines to protect patients and the public

We prevent injury, illness and premature death.

Answered **43,000** calls on the 988/ Suicide and Crisis Lifeline

Performed over **250,000** lab tests for infection

Help **thousands** of people manage chronic diseases

Conducted **10,000** inspections to enforce new laws preventing

Distributed over **110,000** naloxone doses and **100,000**

Governor Healey Signs Executive Order Establishing Artificial Intelligence (AI) Strategic Task Force

Governor to seek $100 million in upcoming Economic Development Bill to create Applied AI Hub in Massachusetts

FOR IMMEDIATE RELEASE:

2/14/2024

Governor Maura Healey and Lt. Governor Kim Driscoll

Executive Office of Technology Services and Security

Executive Office of Economic Development

MEDIA CONTACT

Karissa Hand, Press Secretary

📞 **Phone**

617-725-4025
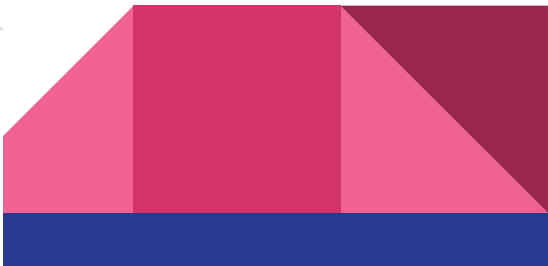
AI in MA Public Health

Massachusetts State Government

- Initiative: Funding for AI in medical research and developing health tech workforce skills.
- Traditional Approach: General research funding and workforce programs lacking AI focus.
- AI Approach: Targeted investments in health sciences AI under the Mass Leads Act for research and workforce development.
- When: 2024
- Why: To make Massachusetts a leader in health tech, attracting partnerships and investments.
- Outcome: In progress, with expectations of bolstering public health using AI.

Link to Resource: Mass Leads Act

AI at Boston Public Health Commission

City of Boston

- Initiative: Predictive analytics for opioid overdose risk using machine learning to identify at-risk individuals and optimize emergency response.
- Traditional Approach: Standard data collection and periodic reporting.
- AI Approach: Machine learning models for real-time prediction and resource allocation.
- When: 2022
- Why: To better address the opioid crisis and reduce overdose fatalities.
- Outcome: Ongoing, with promising results in faster and more effective emergency responses.

AI at the Chicago Department of Public Health

City of Chicago

- Initiative: AI-driven restaurant inspections using predictive models to identify high-risk establishments, leveraging data like weather, crime, and sanitation complaints.
- Traditional Approach: Routine, equally scheduled inspections.
- AI Approach: Risk-based prioritization for efficient resource use.
- When: 2015
- Why: To inspect higher-risk restaurants sooner and enhance public health.
- Outcome: Faster violation detection and improved public safety.

Link to Resource: Chicago Department of Public Health

Exposure to Lead Paint

4.3 million children reside in US homes with lead paint in 2019

Despite some improvements, such as funding, racial and other disparities remain statistically significant

https://pmc.ncbi.nlm.nih.gov/articles/PMC9897265

Lead Poisoning Prevention Investments by Federal Agency, 2000 - 2022
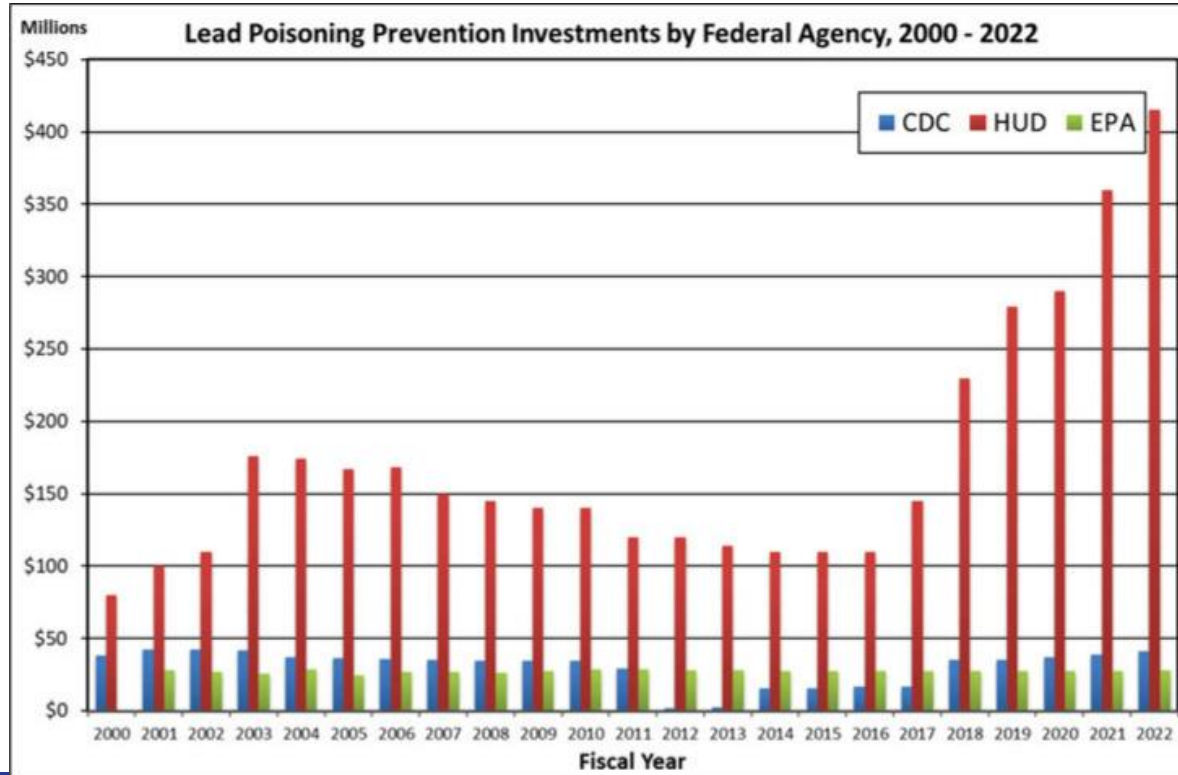
Solutions

Raise awareness and educate, such as with this CDC Infographic

Use AI

https://www.cdc.gov/lead-prevention/prevention/index.html

Lead can be found throughout a child's environment.

① Homes built before 1978 (when lead-based paints were banned) probably contain lead-based paint.

When the paint peels and cracks, it makes lead dust. Children can be poisoned when they swallow or breathe in lead dust.

② Certain water pipes may contain lead.

③ Lead can be found in some products such as toys and toy jewelry.

④ Lead is sometimes in candies imported from other countries or traditional home remedies.

⑤ Certain jobs and hobbies involve working with lead-based products, like stain glass work, and may cause parents to bring lead into the home.

Chicago Department of Public Health (CDPH) Case Study #1

Problem: Childhood Lead Poisoning in Chicago

- **81**% of Chicago's **1.2 million** housing units were built before **1978,** the year lead-based paint was banned
- In 2017, only **1713** new elevated blood lead level (EBLL) cases were **reported**, and **567 inspections** were performed

Traditional Solution: Reactive, not Proactive, Intervention

- Relied on home inspections **after** a child was already diagnosed with EBLL
- Did not prioritize resources effectively for **primary prevention** before a child developed EBLL

Chicago Department of Public Health (CDPH): Solution #1

Better Solution: Logistic Regression

- **Statistical model** that predicted the **probability of EBLL** based on input factors such as housing age, income, and racial/ethnic demographics.
- Represented a **shift** toward **primary intervention**, predicting areas with higher risk of EBLL rather than **reacting** to reported cases.

Limitations with this approach:

- Assumed a **linear relationship** between predictors and outcomes, e.g., as housing age increases, risk of lead poisoning increases at a constant rate
- Does not account for more **complicated, nuanced datasets**, e.g., historical lead levels in the neighborhood, specific building violations

Chicago Department of Public Health (CDPH): Solution #2

Innovation using AI: Machine Learning

- A **machine learning** model, called a **random forest model**, analyzed **over 1000 predictors** from diverse data sets including housing, neighborhood characteristics, and historical lead levels
- Trained on historical data from Chicago **Women, Infants and Children (WIC) program**
- Used a collection of **decision trees** using these predictors to identify the **likelihood of EBLL** for each child or household
- Since this model can **handle diverse data sources** and incorporate new data, this solution is **highly customizable** for other cities (like **Cambridge**)
- This model can identify features **unique to each city** that contribute the most to exposure of lead paint

Chicago Department of Public Health (CDPH): Solution #2

Results:

Random Forest Model **outperformed** Logistic Regression in **every metric** and threshold:

Metric	Random Forest Model	Logistic Regression Model
PPV Value (accuracy in identifying children at risk)	15.5%	7.8%
Sensitivity (ability to identify high-risk children)	16.2%	8.1%

Link to Study:
https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2770650

Chicago Department of Public Health (CDPH) Case Study #2

Problem: Urban Rodent Infestation

- Chicago has been rated the "rattiest" city in the United States for the last decade.
- Over 53,000 rat complaints reported in the last 10 months itself.

Traditional Solution: Reactive, not Proactive, Intervention

- Crews would respond to resident complaints, after infestations become noticeable.
- Without any predictive tools, resources were deployed randomly and reactively, often missing unreported infestations or recurring problem areas.

Chicago Department of Public Health (CDPH) Case Study #2

Innovation using AI: Predictive Analytics

- The **AI-driven model** integrated data multiple datasets to identify patterns associated with rodent infestations:
  311 complaint calls from residents, **geographic** and **environmental data** (eg. neighborhood layout, sanitation conditions), **historical** rodent infestation data
- The model identified a **relationship** between **garbage complaints** and **rodent infestations**: Garbage complaints in a specific area was followed by rodent complaint within **7 days**
- The model **predicted locations** where rodents were **likely to occur** based on data patterns
- Crews were sent to this area **before residents reported infestations**, focusing on **hotspots** identified by the predictive model

https://journals.lww.com/jphmp/fulltext/2015/01001/a_bright_future__innovation_transforming_public.8.aspx

Foster awareness, understanding, and trust among stakeholders - the "public" in public health

Awareness, Knowledge, and Trust

ChatGPT use has ticked up since July, particularly among younger adults
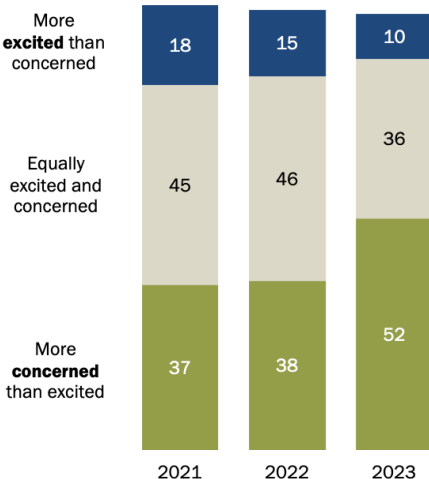
% of U.S. adults who say they have ever used ChatGPT

Ages 18-29 33 → 43
30-49 21 → 27
U.S. adults 18 → 23
50-64 13 → 17
65+ 4 → 6

Jul '23 — Feb '24
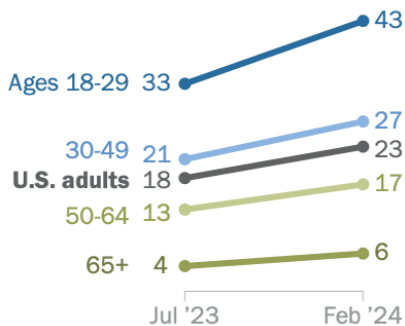
Note: Those who did not give an answer are not shown.
Source: Survey of U.S. adults conducted Feb. 7-11, 2024.

PEW RESEARCH CENTER

Concern about artificial intelligence in daily life far outweighs excitement

% of U.S. adults who say the increased use of artificial intelligence in daily life makes them feel …

	2021	2022	2023
More **excited** than concerned	18	15	10
Equally excited and concerned	45	46	36
More **concerned** than excited	37	38	52

Note: Respondents who did not give an answer are not shown.
Source: Survey conducted July 31-Aug. 6, 2023.

PEW RESEARCH CENTER

Level of willingness to trust and accept artificial intelligence (AI) systems in healthcare worldwide in 2022

Share of respondents

	Unwilling	Ambivalent	Willing
	25%	31%	44%
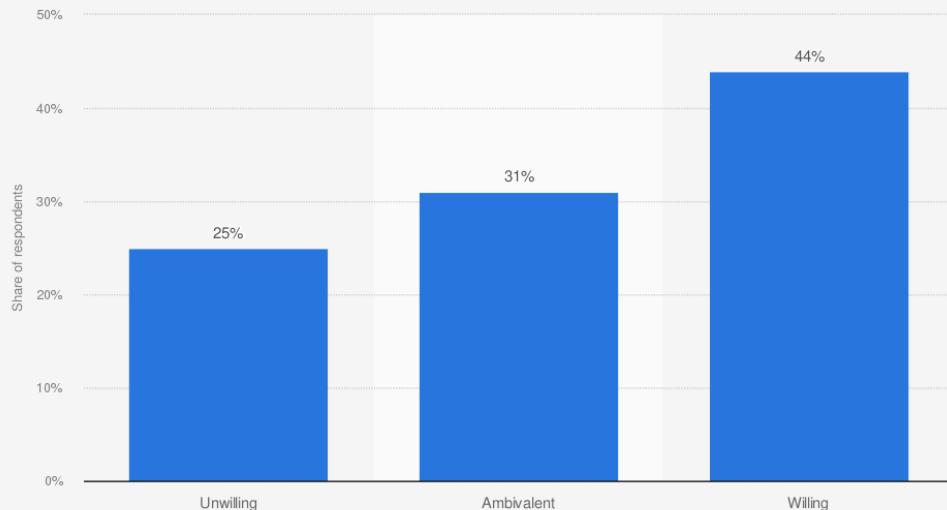
Sources
UQ; KPMG
© Statista 2024

Additional Information:
Worldwide; Australia; Brazil; Canada; China; Estonia; Finland; France; Germany; India; Israel; Japan; South Korea; Nethe
United Kingdom; United States; UQ; KPMG; September to October 2022

Will AI Improve Healthcare?

+ Medical error: 40% vs. 27% of US adults think the use of AI in medicine will reduce rather than increase the number of mistakes made by providers

+ Reduce bias: 51% say the problem of bias and unfair treatment would get better if AI was used more to diagnose disease and recommend treatments

− Patient-provider communication: 57% express concern about AI's impact on the personal connection between a patient and provider

**−** Security: 37% think using AI will make the security of patients' records worse (Pew 12/22 survey)

Fewer than half in U.S. expect artificial intelligence in health and medicine to improve patient outcomes

% of U.S. adults who say that thinking about the use of artificial intelligence in health and medicine to do things like diagnose disease and recommend treatments ...

They would feel __ if their health care provider relied on it for their medical care

Comfortable 39 | 60 Uncomfortable
No answer 1
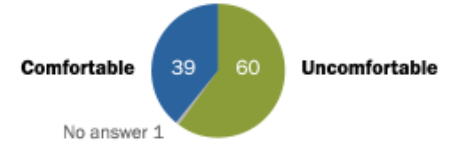
It would lead to __ health outcomes for patients
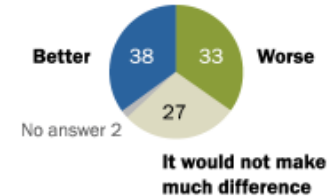
Better 38 | 33 Worse
No answer 2
27
It would not make much difference

Source: Survey conducted Dec. 12-18, 2022.
"60% of Americans Would Be Uncomfortable With Provider Relying on AI in Their Own Health Care"
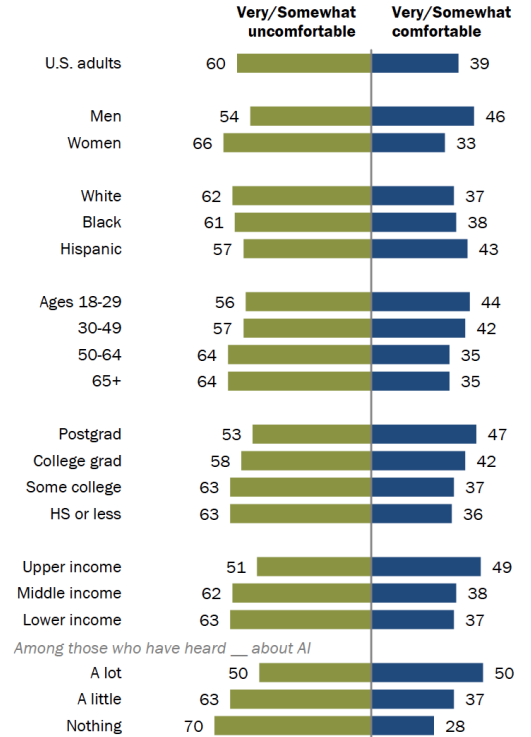
PEW RESEARCH CENTER

Demographics

+ Highest comfort: higher income and education levels

− Lowest comfort – women and adults 50+

? Should this be addressed? Think about not only what AI can do but **how to increase awareness of, education about, and trust in AI**

Majority of U.S. adults would be uncomfortable if their health care provider relied on artificial intelligence

% of U.S. adults who say that they would feel ___ if their health care provider relied on artificial intelligence to do things like diagnose disease and recommend treatments

	Very/Somewhat uncomfortable	Very/Somewhat comfortable
U.S. adults	60	39
Men	54	46
Women	66	33
White	62	37
Black	61	38
Hispanic	57	43
Ages 18-29	56	44
30-49	57	42
50-64	64	35
65+	64	35
Postgrad	53	47
College grad	58	42
Some college	63	37
HS or less	63	36
Upper income	51	49
Middle income	62	38
Lower income	63	37

Among those who have heard ___ about AI

	Very/Somewhat uncomfortable	Very/Somewhat comfortable
A lot	50	50
A little	63	37
Nothing	70	28

Note: Respondents who did not give an answer are not shown. White and Black adults include those who report being only one race and are not Hispanic. Hispanics are of any race. Family income tiers are based on adjusted 2021 earnings.
Source: Survey conducted Dec. 12-18, 2022.
"60% of Americans Would Be Uncomfortable With Provider Relying on AI in Their Own Health Care"

PEW RESEARCH CENTER

How can AI help you?