

# The Role of AI in Modernizing Pharmacy Practice: *Challenges & Opportunities*

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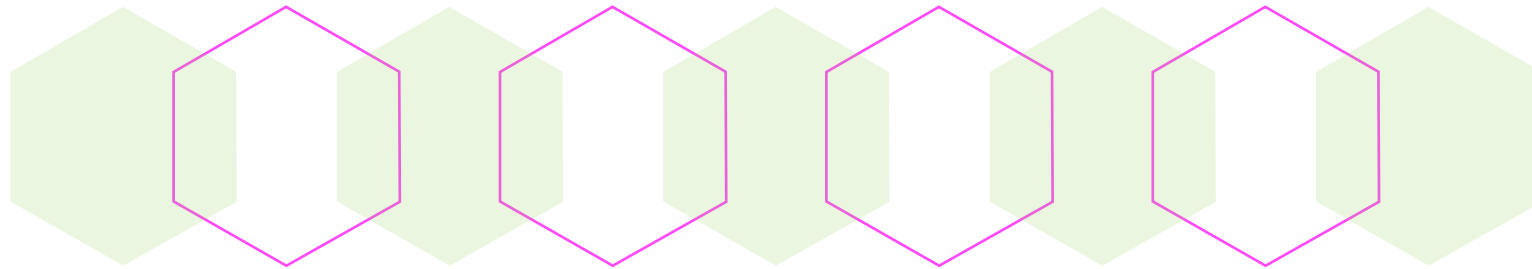
August 23, 2024



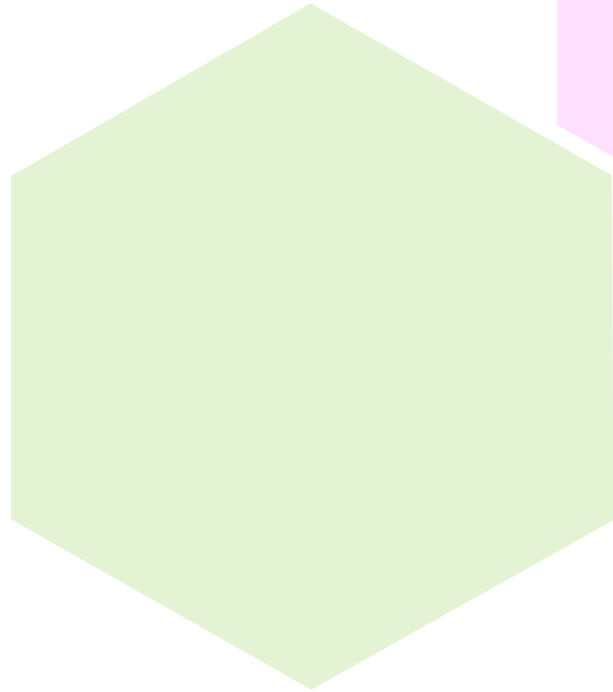
**COLEGIADOS...UNIDOS  
SOMOS MÁS FUERTES**

**CONVENCIÓN ANUAL  
CFPR 2024**

# Disclosure to Learners



**Dr. Gilberto Crespo-Pérez**, faculty for this CE activity, has no relevant financial relationship(s) with ineligible companies to disclose.



***“The *Colegio de Farmacéuticos de Puerto Rico* is  
accredited by the  
Accreditation Council for Pharmacy Education as  
a provider of continuing pharmacy education.”***

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# Objectives

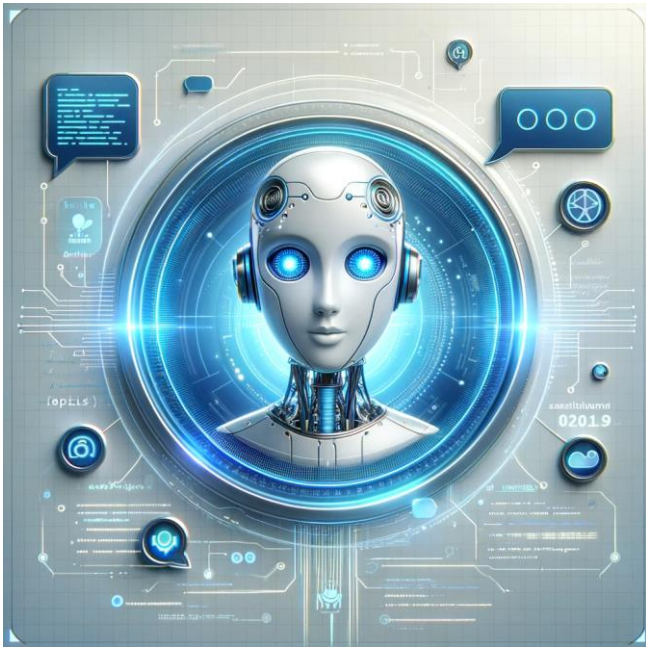
- ✓ Define the fundamental concepts of AI and its transformative impact on pharmacy practice.
- ✓ Identify key features, functionalities, benefits, and limitations of generative AI tools in pharmaceutical environments.
- ✓ Describe through examples the practical implementation of AI in pharmacy, highlighting real case studies and measurable results.



# Agenda

- Welcome & Introduction
- AI in Healthcare Overview
- AI Fundamentals Relevant to Pharmacy
- Drivers of AI Integration in Pharmacy
- Addressing Challenges
- Opportunities Leveraged Through AI
- In-depth Look at AI in Medication Management
- AI's Role in Enhancing Patient Safety
- AI & Professional Development
- Q&A
- Contact Info

# Welcome



**ChatGPT Prompt:** “Saludar y dar la bienvenida a la audiencia participante de la capacitación del Colegio de Farmacéuticos de Puerto Rico sobre esta presentación. La bienvenida debe ser breve, en español e inglés, y no debe durar más de un minuto y treinta segundos.”

**When I hear about GenAI my first  
feeling is...**



**Fear**





JOB

JOB DISSECTON

AI

JOB PLANNING

AI

AI

**Job Displacement**

GENERATIVE AI

AI



DEEPPAKE VIDEO

DEEPPAKE



PRIVACY  
BREAKE  
EXPOSED

DATA  
EXPOSED

DTINA FAKE



# Security & Ethical Concerns



AUTOMATION & PASSIVE AI

AI 2.2.2.9

Excitement

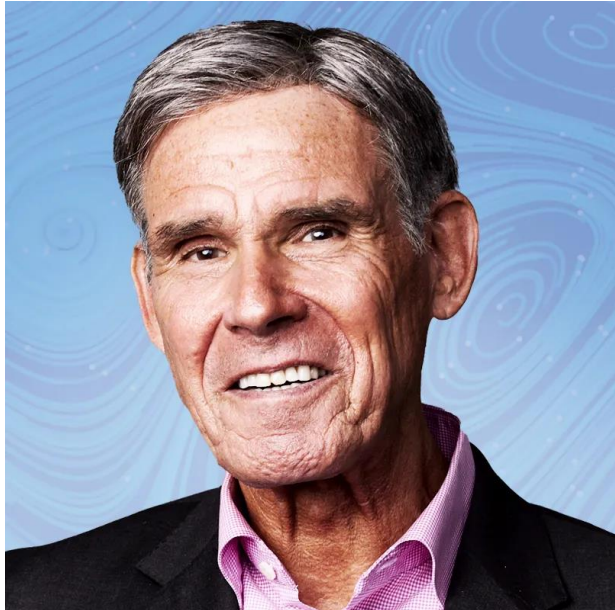


**I don't have any feelings about AI**

Technology won't replace the pharmacist, but pharmacists who cannot leverage it will be ***OUTPACED.***



# One of the Most Cited Scientists Working Today



“Artificial intelligence will allow us to **regain the humanity of healthcare**, as the potential of technology will free up doctors to **spend more time interacting with their patients.**”

*Dr. Eric Topol*

# Introduction to AI in Healthcare

## Definition:

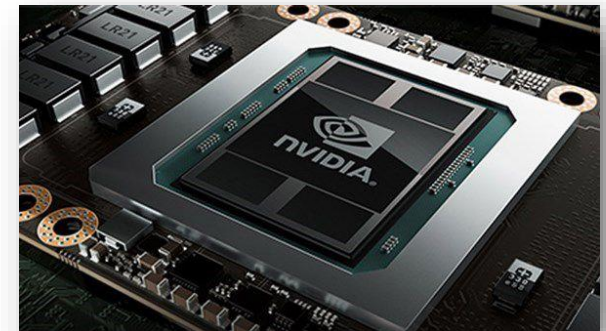
Artificial Intelligence (AI) refers to the ***capability of a machine to imitate intelligent human behavior***. It encompasses a broad range of technologies that enable machines to sense, comprehend, act, and learn.

## Scope:

In healthcare, AI includes applications like diagnostic algorithms, personalized medicine, treatment protocol development, patient monitoring and care, robotics, and healthcare management systems. AI technologies used include machine learning, natural language processing, and robotics.

# Introduction to AI in Healthcare: Evolution

- **Beginnings:** AI's roots in healthcare can be traced back to the 1960s with the development of the first clinical decision support systems.
- **1980s-1990s:** Pioneering systems like MYCIN and CADUCEUS were developed to diagnose diseases and recommend treatments based on the symptoms presented.
- **2000s-Present:** Rapid advancements in data handling and computational power have led to more sophisticated applications such as predictive analytics, image interpretation, and genetic sequencing.





# Introduction to AI in Healthcare: Evolution (Cont.)

## Transformative Impacts:

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**Diagnostic Accuracy:** AI applications in image analysis for radiology and pathology have significantly improved diagnostic accuracy.

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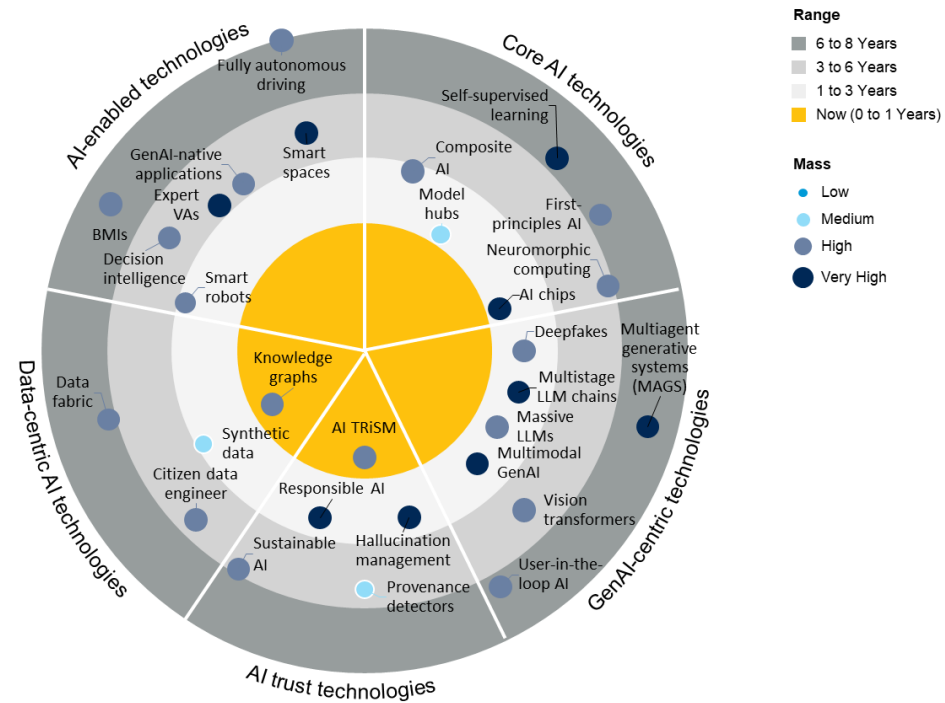
**Operational Efficiency:** AI has optimized scheduling, patient flow, and inventory management in healthcare facilities.

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**Personalized Treatments:** AI-driven analysis of genetic data has advanced the development of personalized medicine, tailoring treatments to individual genetic profiles.

# Introduction to AI in Healthcare: Evolution (Cont.)

Emerging Tech Impact Radar — Artificial Intelligence

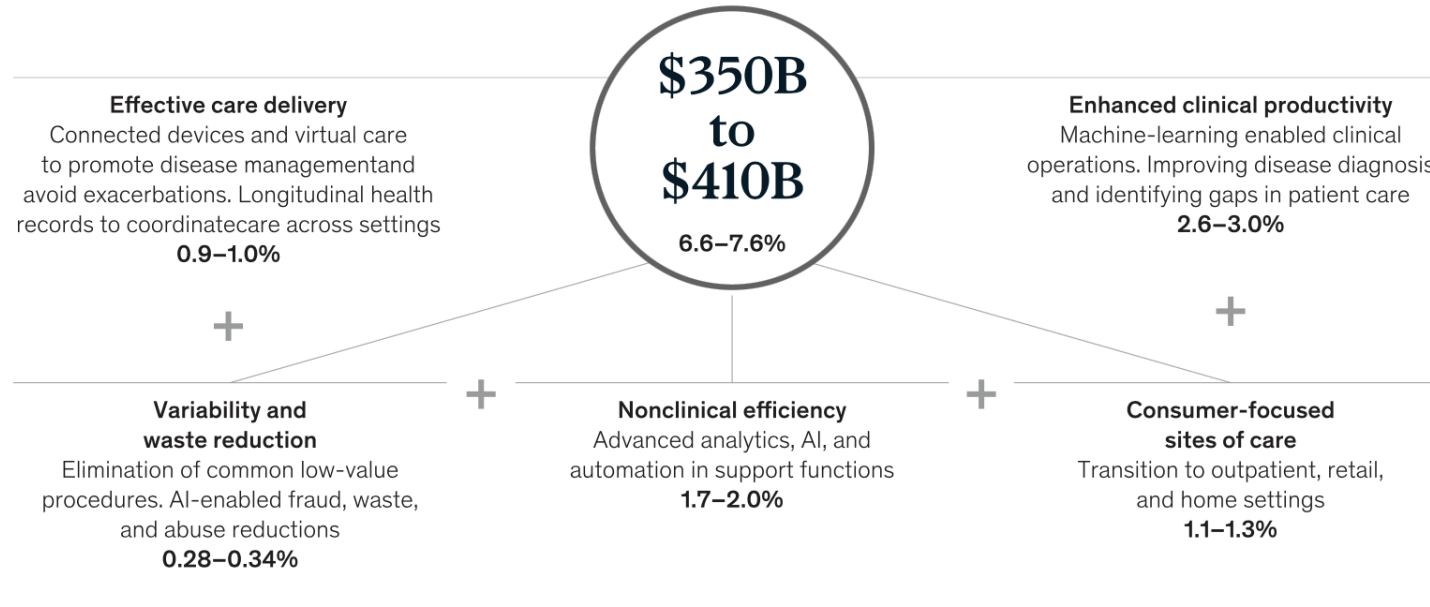


Source: Gartner (January 2024)  
796195

Gartner.

# Introduction to AI in Healthcare: Evolution (Cont.)

Technology-driven innovation holds the potential to improve our understanding of patients, enable the delivery of more convenient, individualized care—and create \$350 billion–\$410 billion in annual



AI, artificial intelligence.

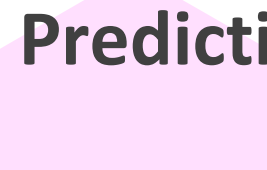
Source: McKinsey analysis

# AI Fundamentals Relevant to Pharmacy



- **Machine Learning (ML):** is a subset of AI that involves training algorithms on data sets to make predictions or decisions, without being explicitly programmed. In pharmacy, ML can be used for predictive analytics such as *forecasting drug demand or predicting patient adherence to medication*.
- **Deep Learning (DL):** is a more complex subset of machine learning involving neural networks with many layers. It is particularly powerful for *processing vast amounts of data and excels in image recognition tasks*, which can be applied in pharmacy for reading and interpreting complex digital images (e.g., scans, molecular structures).
- **Natural Language Processing (NLP):** involves the ability of computers to *understand and process human language*. In pharmacy, NLP is used to process and analyze patient records, extract information from scientific papers, and facilitate communication between patients and digital health assistants.

# How These AI Technologies Process Data and Make Predictions or Decisions



## Data Processing

AI technologies start with data collection, followed by data cleaning and preparation.

## Training

The clean data is then used to train algorithms.

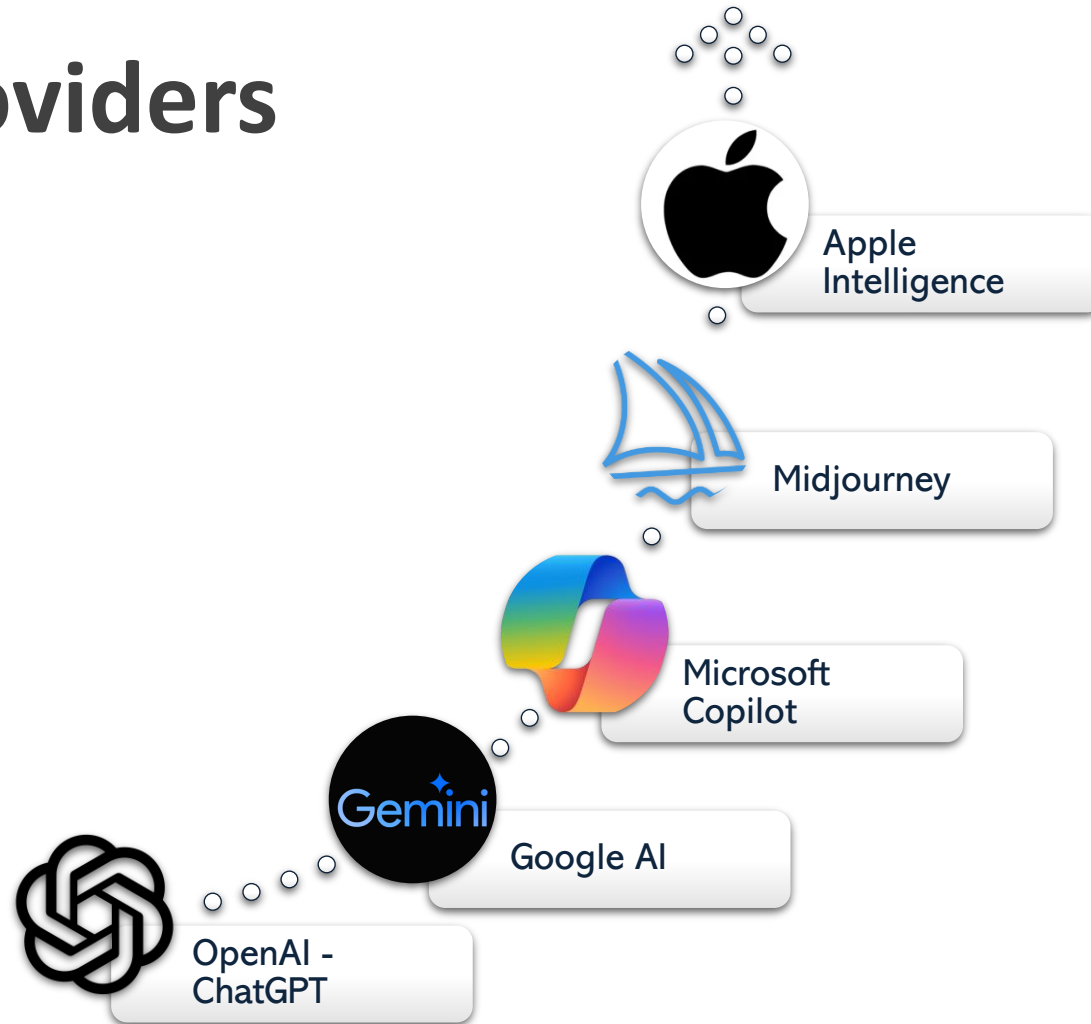
## Prediction & Decision Making

Once trained, these algorithms can make predictions or decisions.

## AI Fundamentals Relevant to Pharmacy: Comparison of AI-driven Systems Versus Traditional Systems in Pharmacy Tasks

- **Efficiency and Speed:** AI-driven systems *can process and analyze data much faster than humans*, reducing the time needed for tasks like medication reviews and patient screening.
- **Accuracy and Precision:** AI systems, particularly those using deep learning, *can achieve higher accuracy in tasks such as dose checking and drug interaction alerts*, where human error might be more likely.
- **Scalability:** Unlike traditional systems, AI *can manage vast amounts of data simultaneously*, making it ideal for large-scale analyses such as monitoring adverse drug reactions across populations.
- **Personalization:** AI systems *can offer more personalized patient care* by utilizing complex algorithms to analyze individual patient data in ways traditional systems cannot, such as customizing drug regimens to an individual's genetic makeup.

# GenAI Model Providers



# Drivers of AI Integration in Pharmacy

Increasing Complexity and Volume of Data in Healthcare

- Complexity of data
- Volume of data

Demand for Personalized Medicine

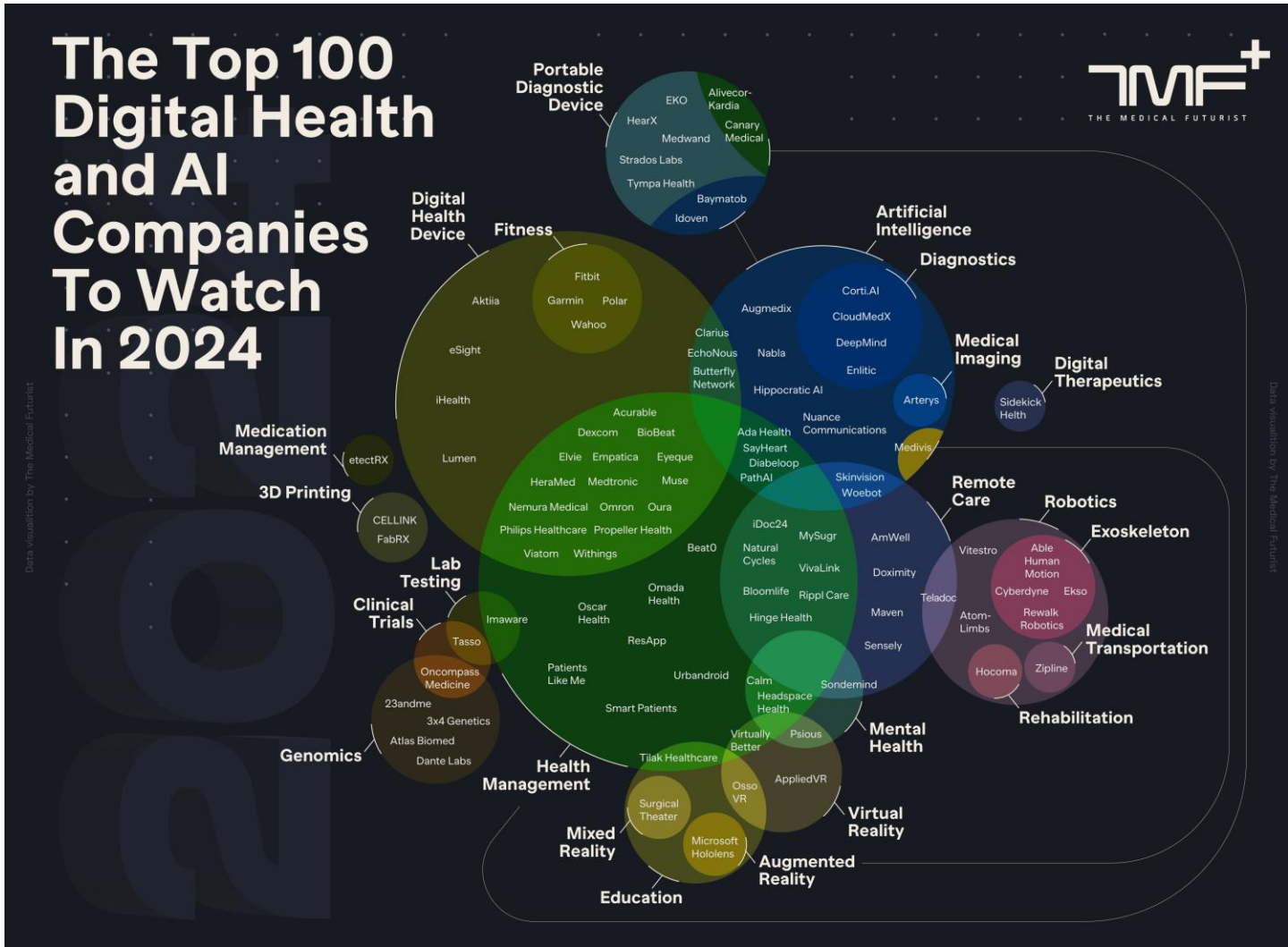
- Role of AI in personalization
- Predictive analytics

Economic Pressures and Efficiency in Pharmacy Operations

- Cost-effectiveness
- Enhancing operational efficiency
- Decision support systems



# The Top 100 Digital Health and AI Companies To Watch In 2024



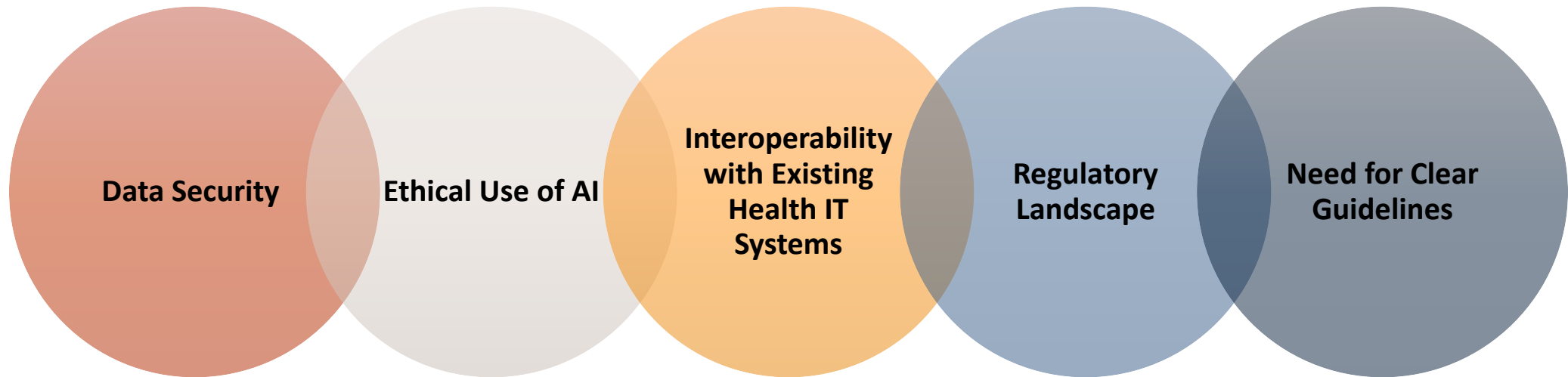
Data visualization by The Medical Futurist.

Data visualization by The Medical Futurist.

# Addressing Challenges



# Addressing Challenges (Cont.)



# How Challenges Are Being Addressed

- ✓ **Institutional Level:** Many healthcare institutions are implementing robust data governance frameworks and ethical guidelines for AI use. Pilot testing of AI solutions and phased rollouts are common strategies to address operational and technical challenges.
- ✓ **National Level:** Governments are increasingly forming task forces and committees to study AI's impact in healthcare, resulting in policies that encourage innovation while ensuring patient safety. Examples include the FDA's evolving guidelines on AI in medical devices.
- ✓ **Global Level:** International collaborations, such as those facilitated by the World Health Organization (WHO), are promoting global standards and frameworks for AI in health to ensure consistency in safety, efficacy, and ethical practices across countries.

# How Challenges Are Being Addressed (Cont.)

## Regulatory Challenges and Guidelines:

- **Regulatory Landscape:** The rapidly evolving nature of AI poses a challenge for regulators who need to ensure that AI tools are safe and effective without stifling innovation. This includes navigating varying regulations across different regions and countries.
- **Need for Clear Guidelines:** There is a critical need for clear, comprehensive guidelines governing AI usage in clinical settings. These guidelines should cover aspects such as validation of AI tools, monitoring of AI interventions, and reporting of AI-related adverse events.

# Opportunities Leveraged through AI

## Enhanced Drug Discovery and Development:

- **Accelerating Research:** AI algorithms can analyze vast datasets quickly, identifying potential drug candidates at a speed impossible for human researchers. This includes using AI to predict molecular behavior and drug efficacy.
- **Reducing Costs:** AI reduces the need for some of the costly phases of drug trials by predicting how drugs will react in the human body, which lowers the risk of late-stage trial failures.
- **Personalized Medicine:** AI helps in the development of personalized drugs based on genetic profiles, enhancing the effectiveness of treatments for individual patients.

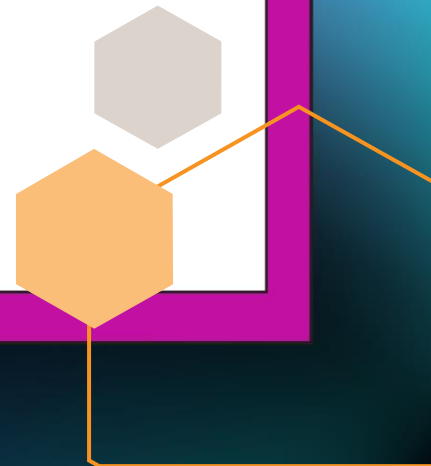
# Opportunities Leveraged through AI (Cont.)

## AI in Inventory Management and Logistics:

- **Automated Inventory Systems:** AI-driven systems can predict inventory needs, manage stock levels in real time, and automatically reorder supplies to prevent overstocking or shortages.
- **Optimized Logistics:** AI optimizes the logistics of pharmacy operations, from warehousing and distribution to point-of-sale. It ensures efficient flow of medications to where they are most needed, improving service delivery.
- **Waste Reduction:** By accurately forecasting demand, AI helps pharmacies minimize expired and unused medications, reducing waste and operational costs.

# Case Studies of Successful AI Applications

- **Case Study 1:** Implementation of an AI system for predicting seasonal flu vaccine demands, leading to a 30% reduction in surplus inventory and ensuring timely availability of vaccines.
- **Case Study 2:** A pharmacy chain uses AI to manage patient data and treatment histories, enhancing medication adherence by customizing communication and dosage recommendations based on individual patient behavior and needs.
- **Case Study 3:** Introduction of robotic dispensing systems in hospital pharmacies that improved dispensing accuracy and reduced medication errors by 50%.

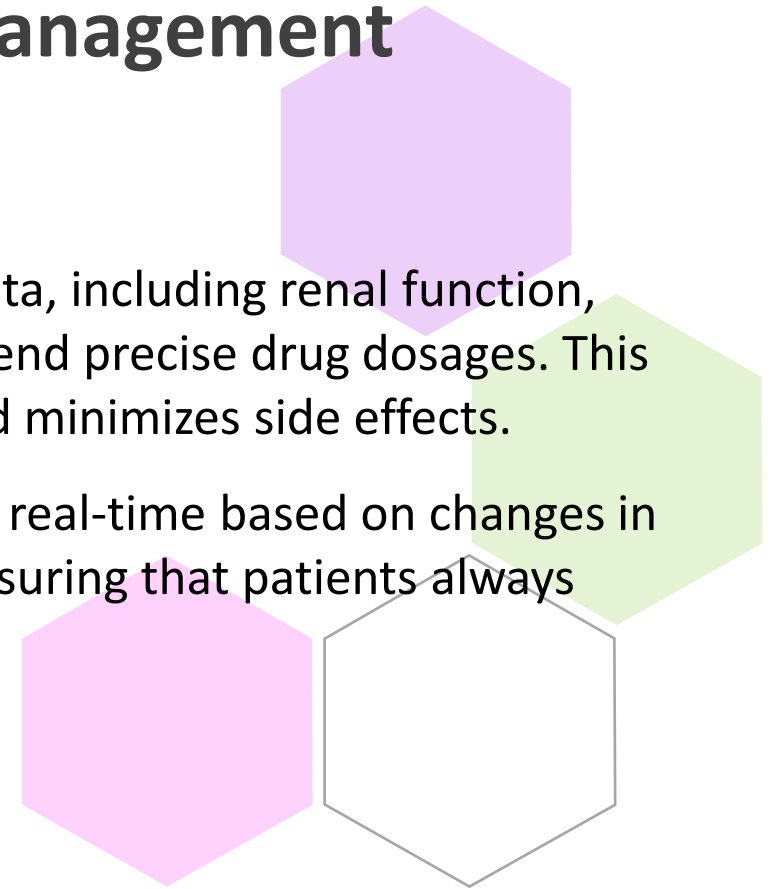




# In-depth Look at AI in Medication Management

## AI in Dosing Recommendations:

- **Personalized Dosing:** AI tools analyze patient-specific data, including renal function, genetic data, and past treatment responses, to recommend precise drug dosages. This personalization helps optimize therapy effectiveness and minimizes side effects.
- **Dynamic Adjustments:** AI systems can adjust dosages in real-time based on changes in patient condition or in response to drug interactions, ensuring that patients always receive the most effective and safest dosage.



# In-depth Look at AI in Medication Management (Cont.)

## Reducing Medication Errors:

- **Automated Checks and Alerts:** AI integrates with pharmacy management systems to provide real-time checks for potential drug interactions, allergies, and other contraindications. Automated alerts notify pharmacists and healthcare providers of any risks before prescriptions are dispensed.
- **Error Prevention:** By automating the verification process, AI significantly reduces human errors that can occur during manual entry or dispensing of medications. This is crucial in high-volume pharmacies or hospitals where the risk of error is amplified.

# In-depth Look at AI in Medication Management (Cont.)

## Managing Complex Regimens for Chronic Diseases:

- **Regimen Coordination:** AI helps in coordinating complex medication regimens for chronic diseases, which often require multiple medications with varying schedules. AI tools can synchronize these regimens to improve adherence and avoid conflicts between multiple prescriptions.
- **Continuous Monitoring and Adjustment:** For chronic conditions like diabetes or hypertension, AI can continuously monitor patient data (e.g., blood sugar levels, blood pressure) and adjust medications as needed in response to fluctuations in health metrics.
- **Predictive Health Insights:** AI can predict potential health crises before they occur by analyzing trends in medication effects and patient vitals, allowing for preemptive adjustments to treatment plans.

# AI's Role in Enhancing Patient Safety

## Monitoring Adverse Drug Reactions and Managing Drug Interactions:

- **Automated Monitoring Systems:** AI tools are used to continuously monitor patients for adverse drug reactions by analyzing real-time data from electronic health records, patient monitoring devices, and other sources. These systems can quickly identify symptoms that may indicate harmful side effects or reactions.
- **Drug Interaction Management:** AI algorithms assess the potential for drug interactions based on a patient's current medications and their unique health profile. This includes complex analyses that consider the biochemical properties of drugs and their interactions with each other, helping pharmacists and physicians make safer prescribing decisions.

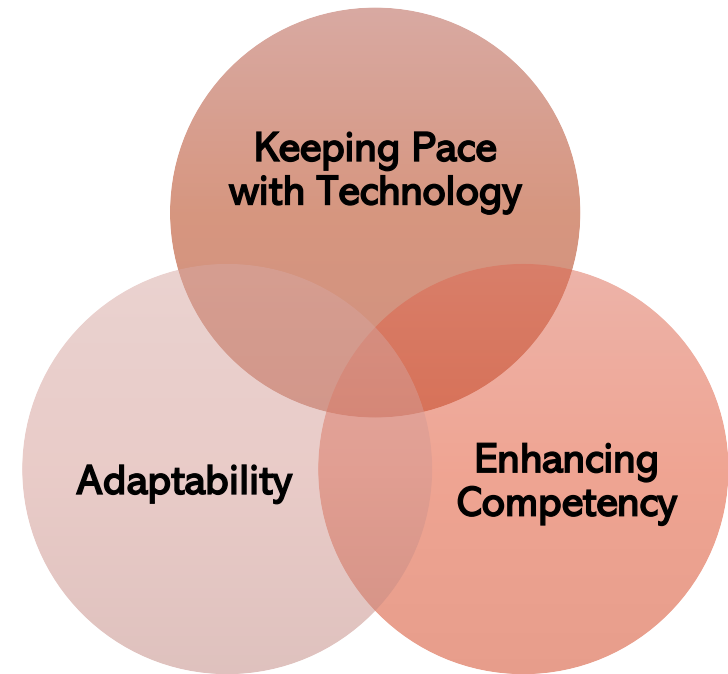
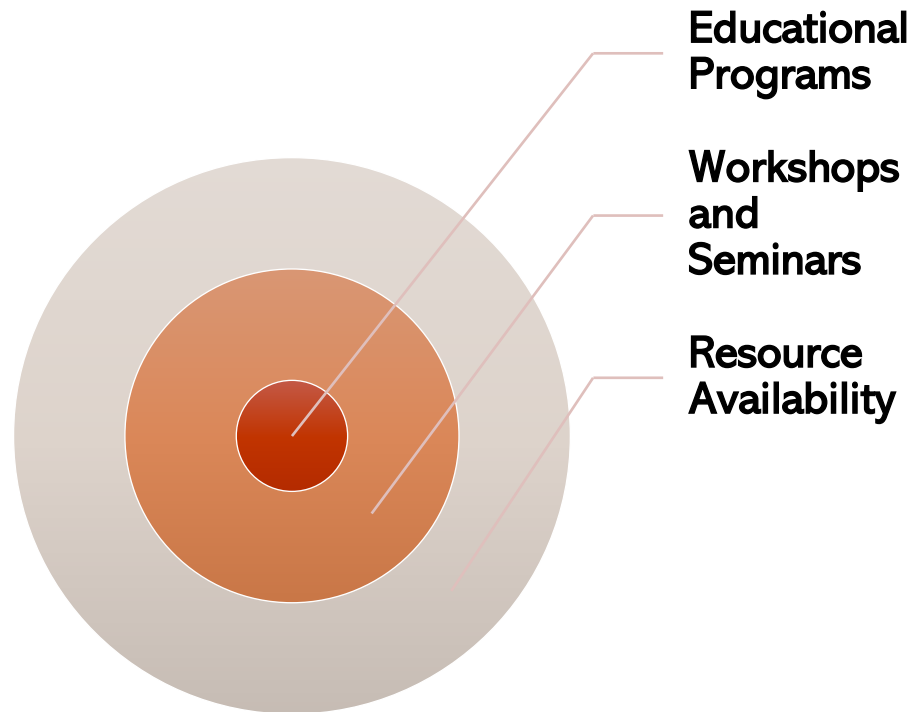
# AI's Role in Enhancing Patient Safety (Cont.)

## Real-Time Clinical Decision Support:

- **Decision Support Tools:** AI provides pharmacists and healthcare providers with decision support tools that offer real-time, evidence-based recommendations. These tools analyze patient information, medical literature, and clinical guidelines to suggest optimal treatments and highlight potential safety issues.
- **Alert Systems:** AI-driven alert systems can notify healthcare professionals of critical issues, such as when a patient's medication needs adjustment due to lab results or other new information. This helps in making swift decisions that can be crucial for patient safety.

# AI and Professional Development

## Current Educational Initiatives and Resources



Importance of Continuous Professional Development

# AI and Professional Development

## Support from Professional Bodies and Associations:

- **Certification and Credentialing:** Provide information on how professional bodies are developing certification programs that recognize pharmacists' proficiency in AI-related skills, thereby setting industry standards.
- **Guidance and Best Practices:** Explain how professional associations are not only offering training but also developing guidelines and best practices for implementing AI in pharmacy operations safely and effectively.
- **Networking and Collaborations:** Discuss the role of professional networks in facilitating collaborations that enable pharmacists to learn from AI experts and peers who are innovatively using AI in their practices.

# Regulatory Framework and Ethical Considerations

OpenAI (ChatGPT) CEO,  
Sam Altman, Worst Fear  
is...







# Regulatory Framework and Ethical Considerations (Cont.)



- AI regulations in force
- Plans to introduce AI regulations
- No current AI regulations and no plans to introduce AI regulations
- No/limited information available on this topic

## Regulatory and Ethical Framework in AI Utilization (ASHP & APhA Statements)



- **Emphasis on Training and Continuing Education:** ASHP highlights the importance of pharmacists receiving ongoing training on new AI technologies to maintain professional competence.
- **Ethical Use of AI:** Stresses the need for AI to be used ethically, ensuring the privacy and security of patient data are preserved.
- **Integration of AI into Healthcare Systems:** Encourages the integration of AI solutions that enhance operational efficiency without compromising patient-centered care.

## Regulatory and Ethical Framework in AI Utilization (ASHP & APhA Statements)



- **Advocacy for Oversight and Regulation:** APhA advocates for clear regulation and oversight of AI usage in pharmacy practice to ensure patient safety and effectiveness.
- **Promotion of Equitable Access:** Urges ensuring that the development and implementation of AI technologies are accessible equitably across all communities to prevent healthcare disparities.
- **Fostering Interprofessional Collaboration:** Promotes collaboration among pharmacists, technologists, and other health professionals to optimize the use of AI in improving health outcomes.

# Regulatory Framework and Ethical Considerations

- **FDA Guidelines:** Discuss the U.S. Food and Drug Administration's (FDA) current guidelines for AI and machine learning in medical devices, focusing on how these guidelines impact AI tools used in pharmacy settings. Highlight key directives around clinical validation, data quality, and algorithm transparency.
- **International Standards:** Provide an overview of international standards and regulations governing AI in pharmacy, such as the European Union's GDPR implications on patient data used in AI systems, and ISO standards for AI ethics and safety.
- **Adherence and Compliance:** Explain the importance of compliance with these regulations and standards to ensure the safe and effective deployment of AI technologies in pharmacy practice.

## Regulatory Framework and Ethical Considerations (Cont.)

- **Patient Consent:** Emphasize the critical need for obtaining informed consent when using AI systems that process patient data, discussing the challenges in ensuring patients understand what AI use entails.
- **Transparency:** Highlight the necessity for transparency in how AI systems make decisions, especially in clinical settings where these decisions can significantly impact patient health outcomes.
- **Accountability:** Address the issue of accountability, particularly who is responsible when AI systems fail or result in adverse outcomes. This includes the responsibility of developers, providers, and pharmacists.

# Regulatory Framework and Ethical Considerations (Cont.)

## Pharmacists' Contribution to Policy Discussions and Ethical Debates:

- **Active Participation:** Encourage pharmacists to actively participate in policy discussions at various levels (local, national, international) to ensure that the pharmacy profession's perspective and expertise are included in policymaking.
- **Ethical Debates:** Discuss how pharmacists can play a crucial role in ethical debates about AI, using their frontline experience to advocate for patient-centric policies and ethical AI practices.
- **Continuing Education and Leadership:** Highlight the importance of pharmacists pursuing continuous education on AI and ethics to lead effectively in policy discussions and serve as ethical role models in the healthcare community.

# NIST Artificial Intelligence Risk Management Framework Playbook

Source: [https://airc.nist.gov/AI\\_RM\\_F\\_Knowledge\\_Base/Playbook](https://airc.nist.gov/AI_RM_F_Knowledge_Base/Playbook)





# Conclusion and Interactive Q&A



**ChatGPT Prompt:** *“Take a deep breath and provide me with a recap of the key points discussed and their implications for pharmacy practice in no more than one minute in Spanish. TEMP 0.2”*



# Post-Test (True or False)

1. CoPilot is an AI tool used in Microsoft.
2. Concerns of national pharmacy associations regarding the use of AI tools include ethical and responsible use of trustworthy AI technology, data privacy and security, model biases, and the accuracy of the tools.
3. Utilizing AI to deliver dosage recommendations for an inpatient unit according to daily renal function represents an application of artificial intelligence in pharmacy settings.
4. One of the biggest barriers of using GenAI is that it can create content that appears correct but is false.
5. FDA has expanded its focus on digital health technologies and the use of AI tools, it has approved diverse AI-based devices in medicine in radiology, oncology, and endocrinology.

# References

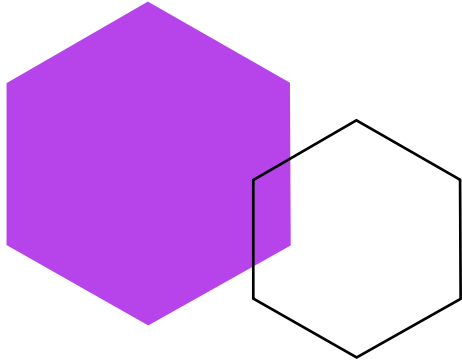
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- NIST AI RMF Playbook: <https://www.nist.gov/itl/ai-risk-management-framework/nist-ai-rmf-playbook>

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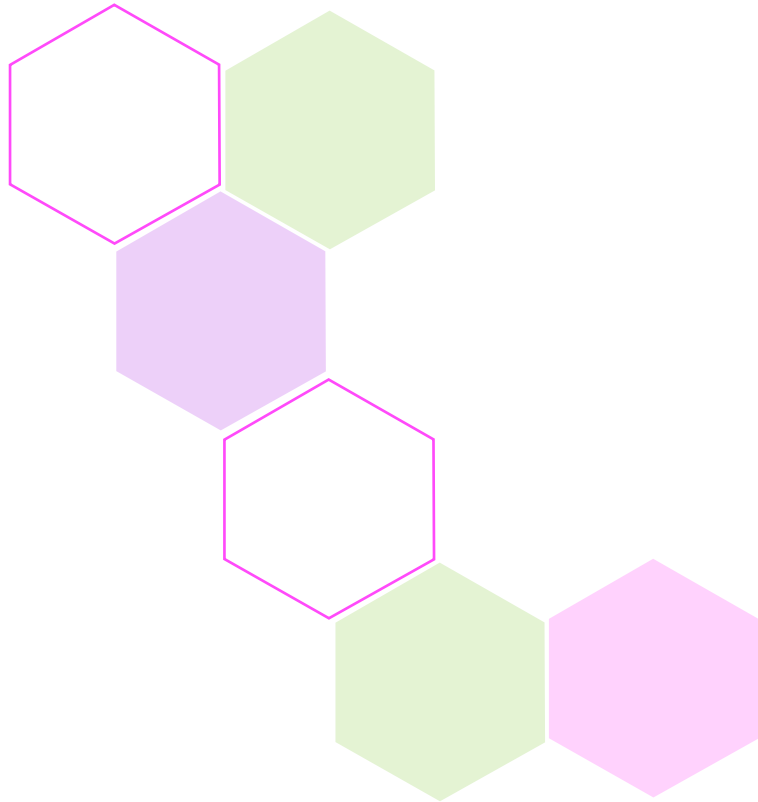


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para completar la evaluación y  
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# Thank you

**Dr. Gilberto Crespo**

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## Contact Info



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