



From COVID to AI in Telepharmacy

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Speaker Disclosure

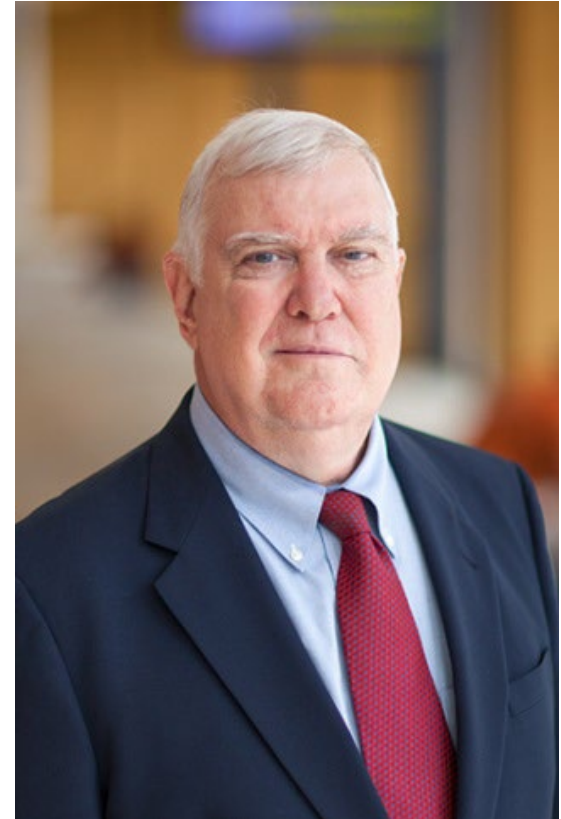
Your speaker for this session is:

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Statement of Disclosure:

I have no vested interest or affiliation with any corporate organization offering financial support of grant money for this continuing education program.

Additionally, I have no vested interest or any affiliation with any organization whose philosophy could potentially bias this presentation.



Learning Objectives for This Session

- Explain the basic applications of telepharmacy technology as they exist today
- Recognize the innovations in telepharmacy services due to the COVID-19 pandemic
- Describe the use of AI in pharmacy that expanded rapidly during and after the COVID-19 pandemic
- Identify the basic features of Narrow AI, which can learn from data and make predictions based on the data, and Generative AI, which can create new formulations from existing data
- Discuss future telepharmacy opportunities and challenges created by AI

Pre-Presentation Questions



Baseline Question 1

The total number of retail pharmacies in the USA have declined since 2018.

- A. Yes
- B. No
- C. Don't know

Baseline Question 2

The greatest reduction of retail pharmacies in the USA occurred in which area?

- A. Rural areas
- B. Rural Micropolitan areas
- C. Suburban areas
- D. Metropolitan areas

Baseline Question 3

Telepharmacy is a form of telehealth.

- A. Yes
- B. No
- C. Don't know

Baseline Question 4

The Florida Board of Pharmacy regulates Telepharmacy in Florida.

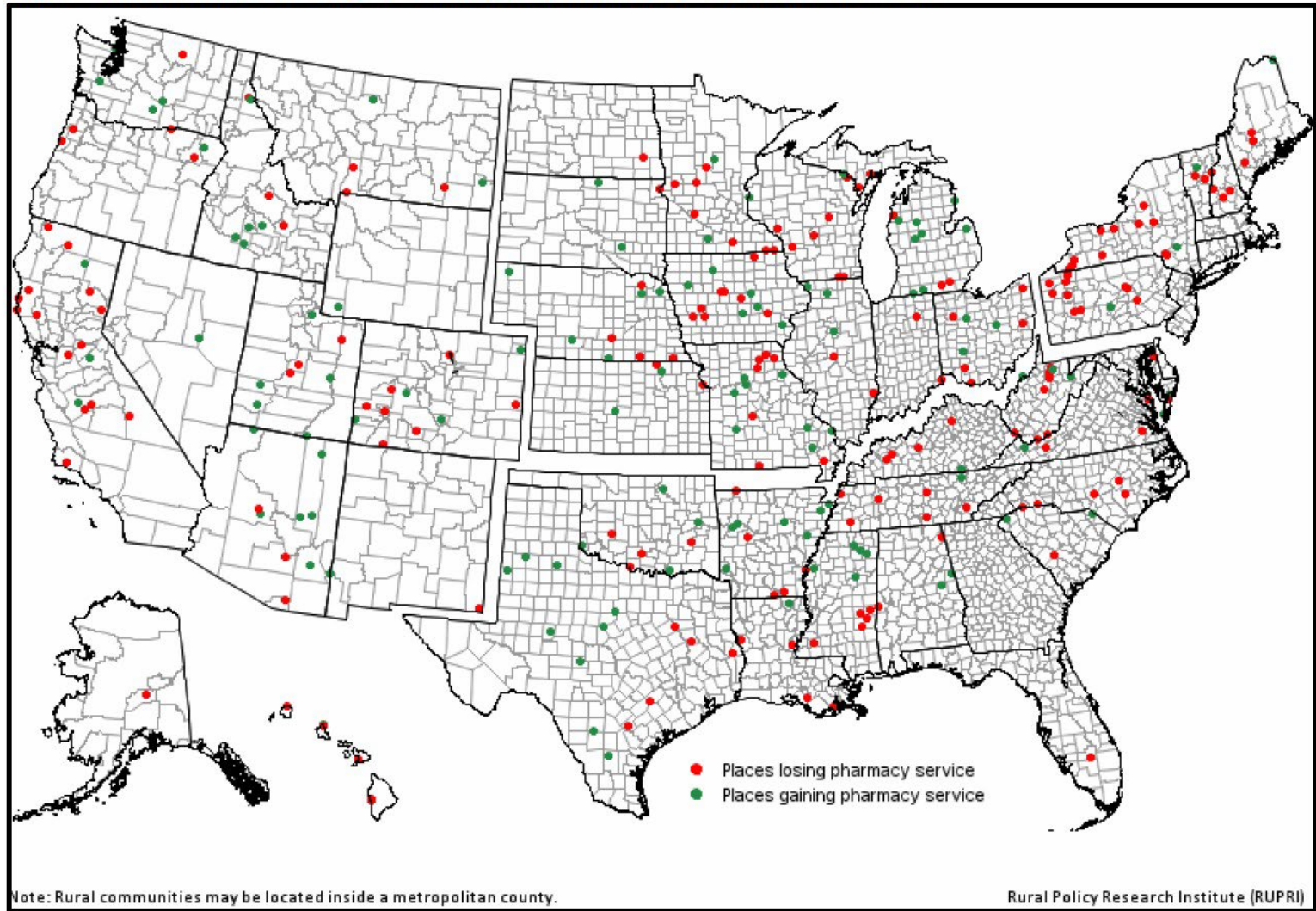
- A. Yes
- B. No
- C. Don't know

Telepharmacy as a Mitigation Strategy to Address the Scarcity of Rural Pharmacies



Pharmacies Closing in Rural Areas

Figure 1. Rural Places Losing or Gaining Any Pharmacy Service: 2018-2023



Nationwide Decline in Retail Pharmacies

Between 2018 and 2023, the number of retail pharmacies in the U.S. declined by 3.9 percent.

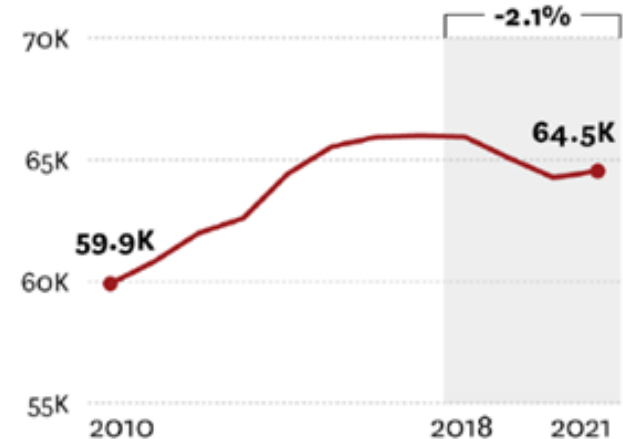
- Rural areas by -5.9 percent
- Urban areas by -3.4 percent.

Starting in 2018, large pharmacy chains began to merge -- and shut down stores deemed not profitable

- Between 2019 and 2021, the number of pharmacies declined in 41 of 50 states

U.S. Pharmacy Numbers Have Declined Overall Since 2018

Net number of pharmacies in operation



Source: Authors' analysis of pharmacy data from the National Council for Prescription Drug Programs

USC Schaeffer

Rural Pharmacy Challenges

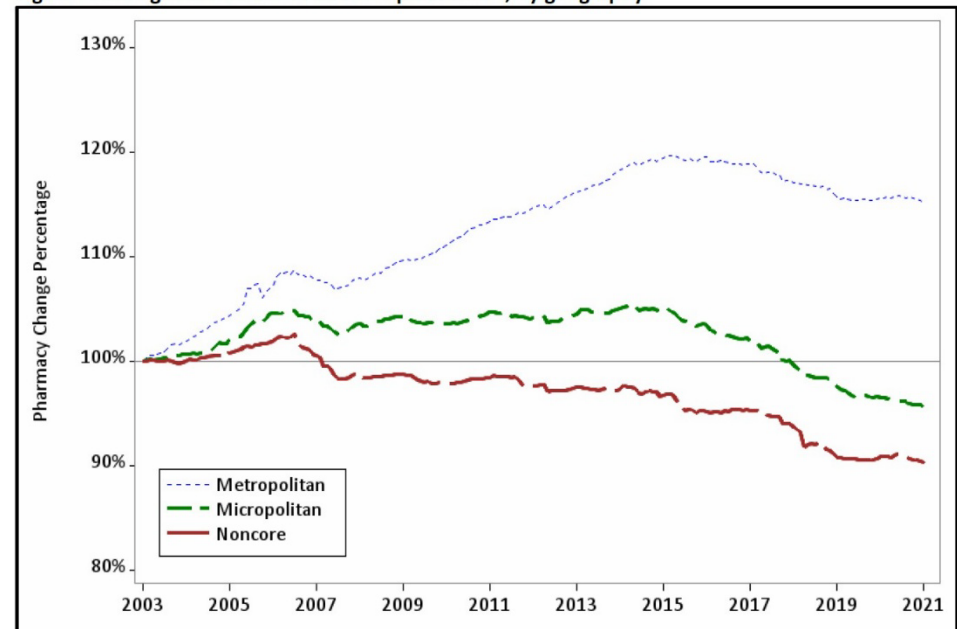
Half of the pharmacies in rural areas are independent

- They are often the only healthcare source in rural areas
- They experienced higher rates of closure than pharmacies in cities

Change in retail pharmacies between 2003 and 2021:

- Noncore Rural areas declined by 9.8%
- Rural Micropolitan areas declined by 4.4%
- Metropolitan areas increased by 15.1%

Figure 1. Changes in number of all retail pharmacies, by geography



Data Source: RUPRI Center analysis of NCPDP data

Telepharmacy as a Mitigation Strategy

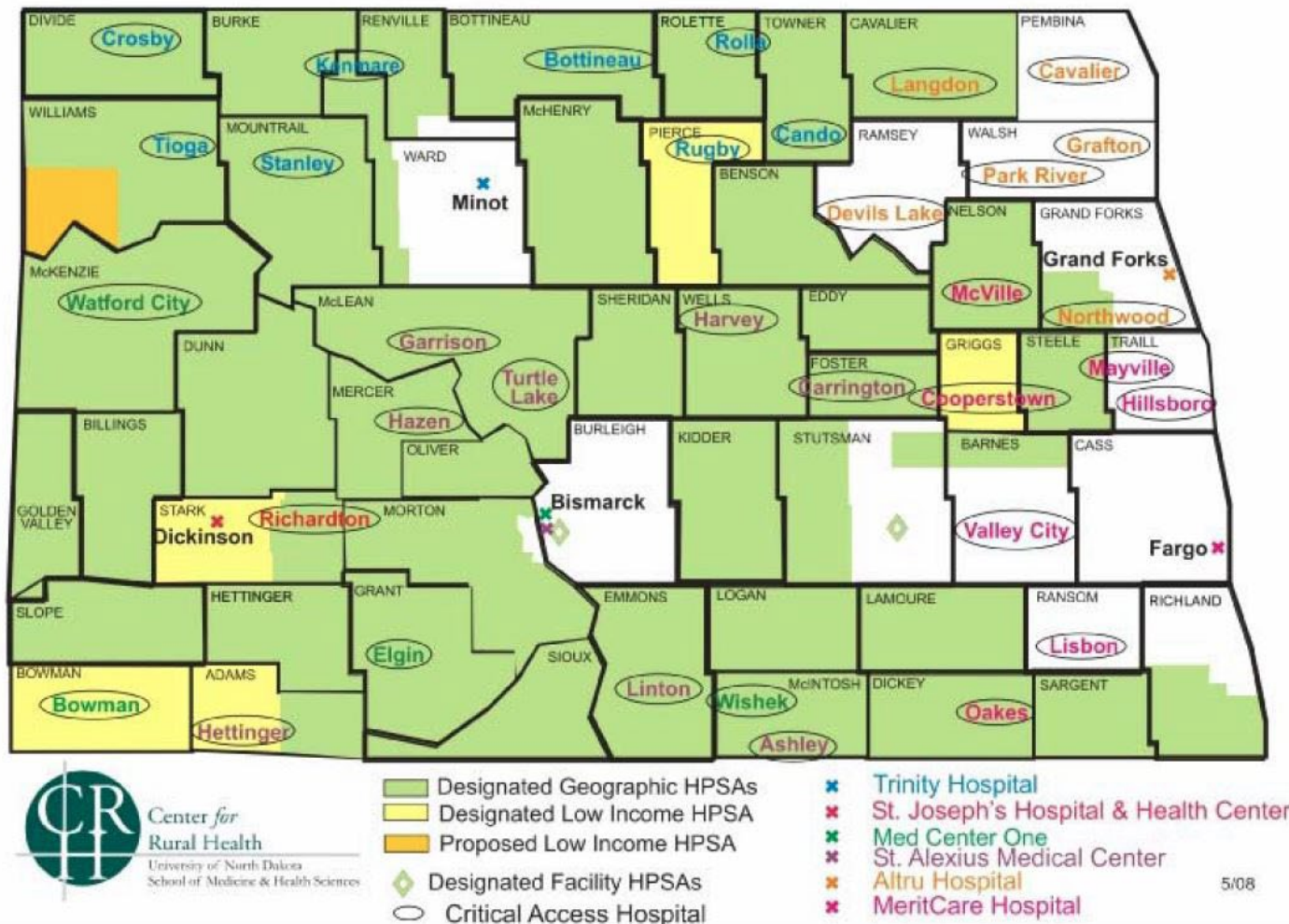


National Association of Boards of Pharmacy

“Practice of Telepharmacy” means the provision of Pharmacist Care Services by registered Pharmacies and Pharmacists located within US jurisdictions through the use of telecommunications or other technologies to patients or their agents at distances that are located within US jurisdictions.

ND Telepharmacy Project – Rural Need

Exhibit 2. North Dakota Health Professional Shortage Areas, Critical Access Hospitals, and Network Affiliates



North Dakota Telepharmacy Project

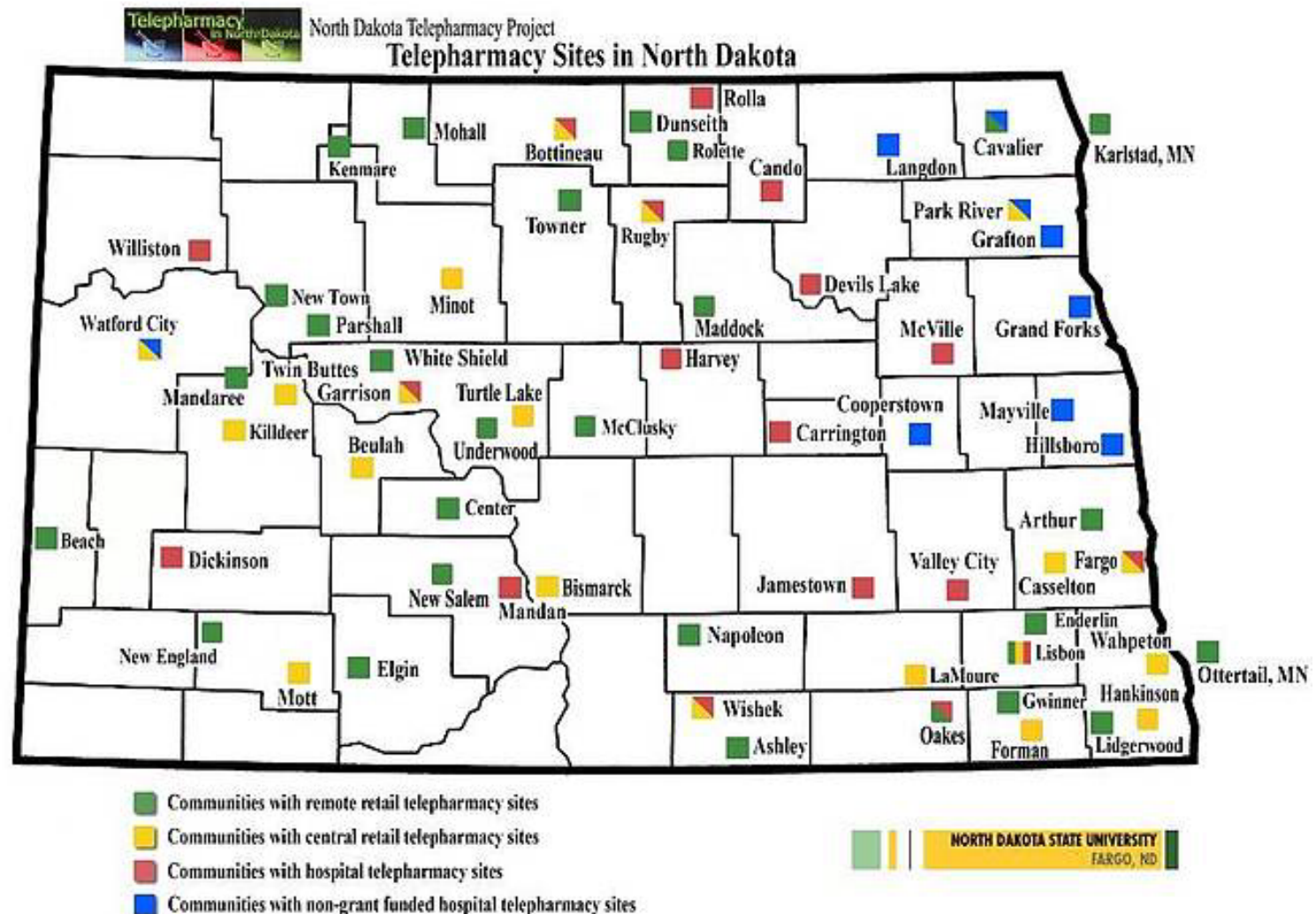


Telepharmacy is working well in North Dakota, restoring pharmacy services for many remote rural communities.

- Telepharmacy services produce the same quality as the traditional mode of delivery
- They also provide some value-added features that are not found in traditional pharmacy practice

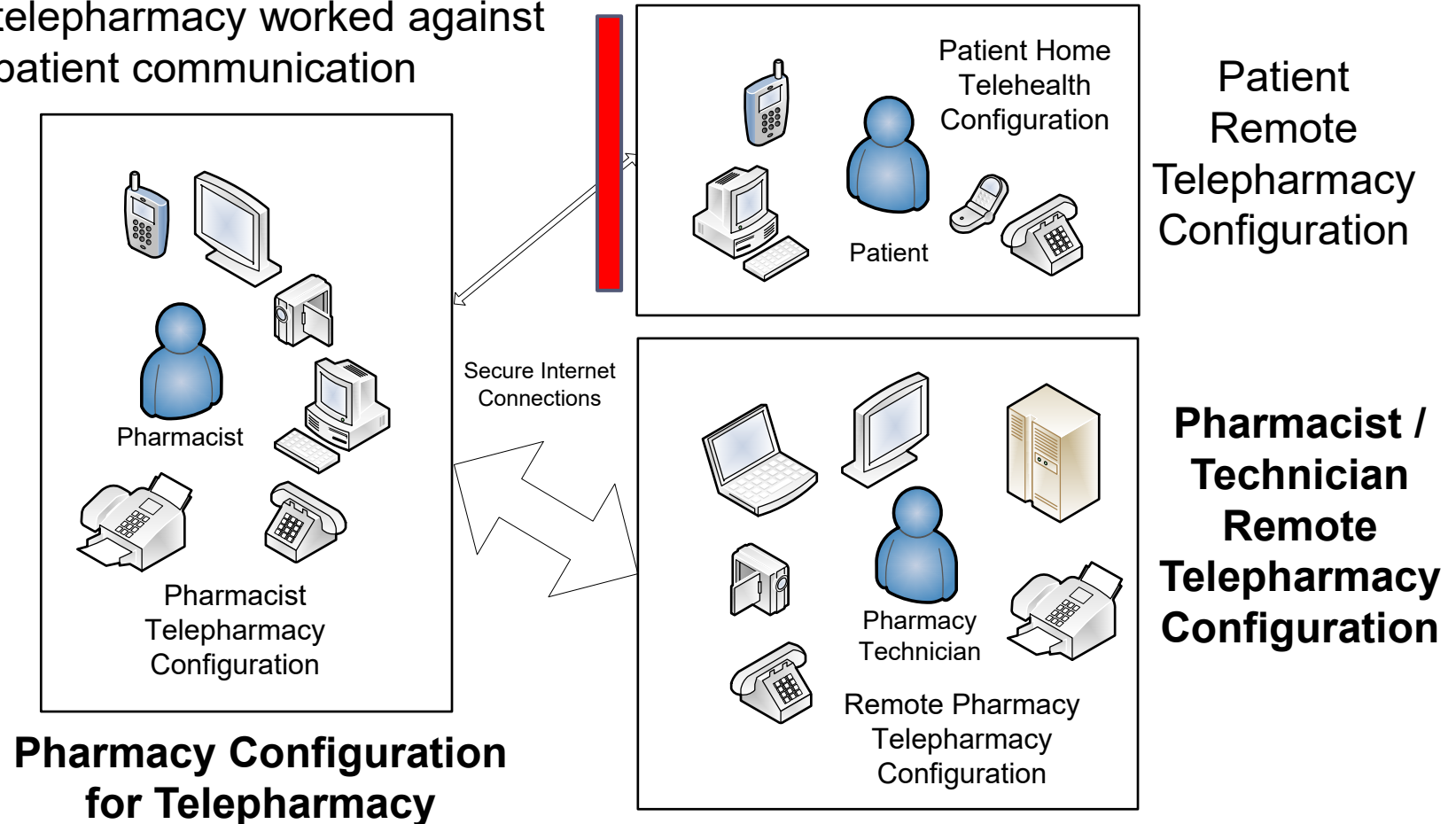
ND Telepharmacy Project Partners

Remote telepharmacy locations in North Dakota



Telepharmacy Model pre-COVID

“Incident to” requirement for telepharmacy worked against patient communication



CMS Rule for Reimbursing Pharmacists

Pharmacists are not included as practitioners who can bill for Medicare services but must bill through a physician or clinic.



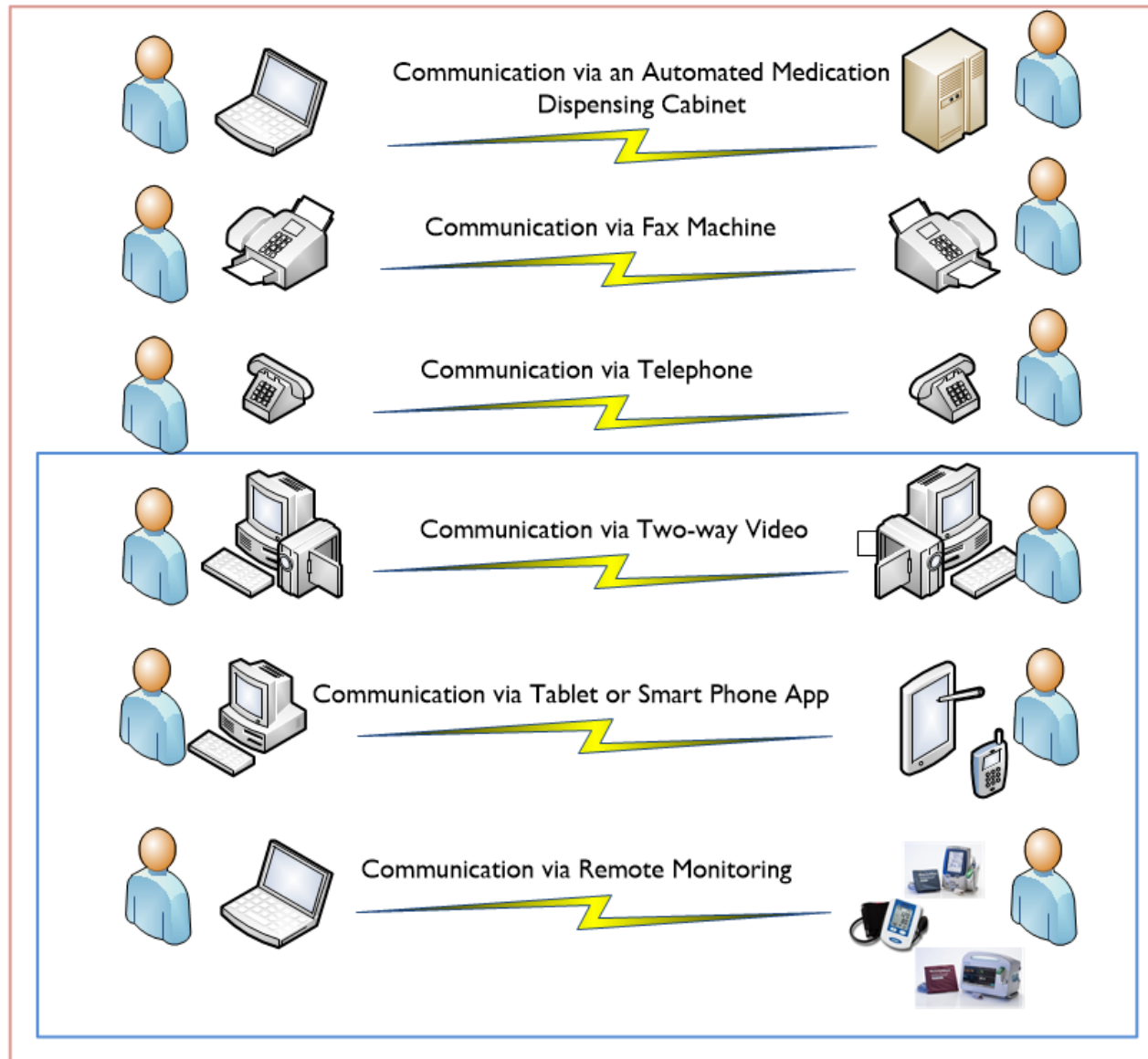
“Pharmacists may **“incident to”** provide services under the supervision of a billing, if payment for the services is not made under the Medicare Part D benefit.”

According to CMS, direct supervision by the physician would be allowed through real-time audio and video technology – essentially through telehealth channels, as telepharmacy was practiced at that time.



Technical Scope of Telepharmacy vs Telehealth

Telepharmacy



Telehealth /
Telemedicine

HIPAA Security Rule

§ 164.312 Technical safeguards

Transmission security:

- Implement technical security measures to prevent unauthorized access to Electronic Protected Health Information (ePHI) transmitted over an electronic communications network.
- Under the HIPAA Omnibus Rule, ePHI that is **not encrypted** is considered “Unsecure” and liable for penalties if breached
- **Encrypted** ePHI is “Secure” and not liable for penalties if breached



States Regulating Telepharmacy

Over half the country permits telepharmacy at some level

- Twenty-two states have not implemented telepharmacy regulations or have policies that limit the practice.



Telepharmacy Services During COVID



How COVID-19 Interfered with Pharmacies

COVID Restricted Physical Access to Pharmacies

- Pharmacies faced lockdown-related closures
- Patients avoided in-person visits due to infection fears

Increased Pressure on Pharmacists for COVID Services

- Pharmacists were put into frontline roles, engaging in COVID-19 testing, vaccination and triage

Increased Demand on Healthcare Workforce

- Community pharmacists had to handle consults via telehealth platforms

How COVID-19 Interfered with Pharmacies

Supply Chain and Medication Shortages

COVID-19 disrupted global pharmaceutical supply chains
Pharmacies struggled to fill prescriptions timely.

- The surge in demand for specific drugs created backlogs
- Lockdowns in manufacturing countries halted production
- Pharmacists had to find alternatives while managing inventory and navigating price fluctuations.
- Hospital pharmacies employed AI and automated inventory systems to predict and manage stockouts effectively

How COVID-19 Interfered with Pharmacies

Hospital pharmacies in the United States introduced AI-assisted inventory platforms OrbitalRX and Micromedex to proactively manage drug shortages

- OrbitalRX is designed to unify supply chain and clinical utilization to manage drug shortages



- IBM Micromedex is one of the largest online reference databases for medication information.
- It covers medication therapy management, disease and condition management, toxicology, alternative medicine and patient education

Consultations via Telehealth

COVID made in-person consultation unsafe, so pharmacists turned to telehealth platforms

- Pharmacists used platforms like Zoom, Google Meet, and WhatsApp to communicate with patients

These platforms were not compliant with HIPAA so issues of privacy and patient consent became major obstacles.

The HHS Office for Civil Rights ruled a “good faith” use of telehealth would not violate the HIPAA Security Rule

- This opened the door for telehealth platforms



Platforms Approved for Telehealth

The HHS Office for Civil Rights approved platforms using encryption, between an individual and another person.

- Apple FaceTime
- Facebook Messenger video chat
- Google Hangouts video
- Whatsapp video chat
- Zoom
- Skype



Products such as TikTok, Facebook Live, Twitch, or public chat rooms were unacceptable because they are designed to be open to the public

FAMU Telehealth Outreach During COVID

Virtual consultation and medication counseling during COVID

Pharmacists used telecommunication platforms like Zoom, Google Meet, and WhatsApp to conduct patient counseling and medication education.



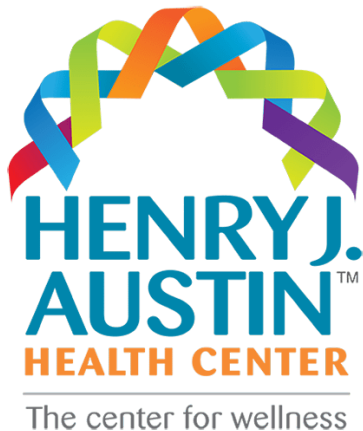
The FAMU College of Pharmacy, working with a Federally Qualified Health Center in Pensacola, FL, introduced a telehealth solution

Student pharmacists worked with pharmacists at the FQHC to assist them interviewing patients and providing medication-related help via telehealth.

The student pharmacists helped formulate care plans and make recommendations to health care providers via Zoom.

Medication Reconciliation via Telehealth

Remote medication order review and reconciliation during COVID
COVID-19 increased the need for remote medication order review and reconciliation using electronic health and secure communication tools.



Pharmacists at the Henry J. Austin Health Center in Trenton, NJ, provided the majority of their clinical services during COVID using telehealth channels

- Pharmacists could prescribe and order labs via telehealth
- Pharmacists used phone and video consultations

Chronic Disease Management via Telehealth

COVID disrupted routine chronic care, making telehealth platforms vital to monitor patients' drug regimens remotely.

- In many remote care models, pharmacists helped adjust regimens for COVID-infected patients



**Rocking Horse
Community Health Center**

Pharmacists providing chronic care management at the Rocking Horse Community Center in Springfield, OH, used telehealth throughout COVID

- Patients enjoyed the ability to join visits from their own home

Chat Room Break

Let's stop here and see if there are any questions in the chat box

How is Artificial Intelligence Defined?

IBM: AI is technology that enables computers and machines to simulate human learning, comprehension, problem solving, decision making and creativity

Google: AI is concerned with building computers and machines that can reason, learn, and act in such a way that would normally require human intelligence

NASA: AI refers to computer systems that can perform complex tasks normally done by human-reasoning, decision making, creating, etc.

NIST: A machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations, or decisions influencing real or virtual environments.

Features of Artificial Intelligence

WHAT IS ARTIFICIAL INTELLIGENCE?

Machine Learning

Using sample data to train computer programs to recognize patterns based on algorithms.



Neural Networks

Computer systems designed to imitate the neurons in a brain.



Natural Language Processing

The ability to understand speech, as well as understand and analyze documents.



Robotics

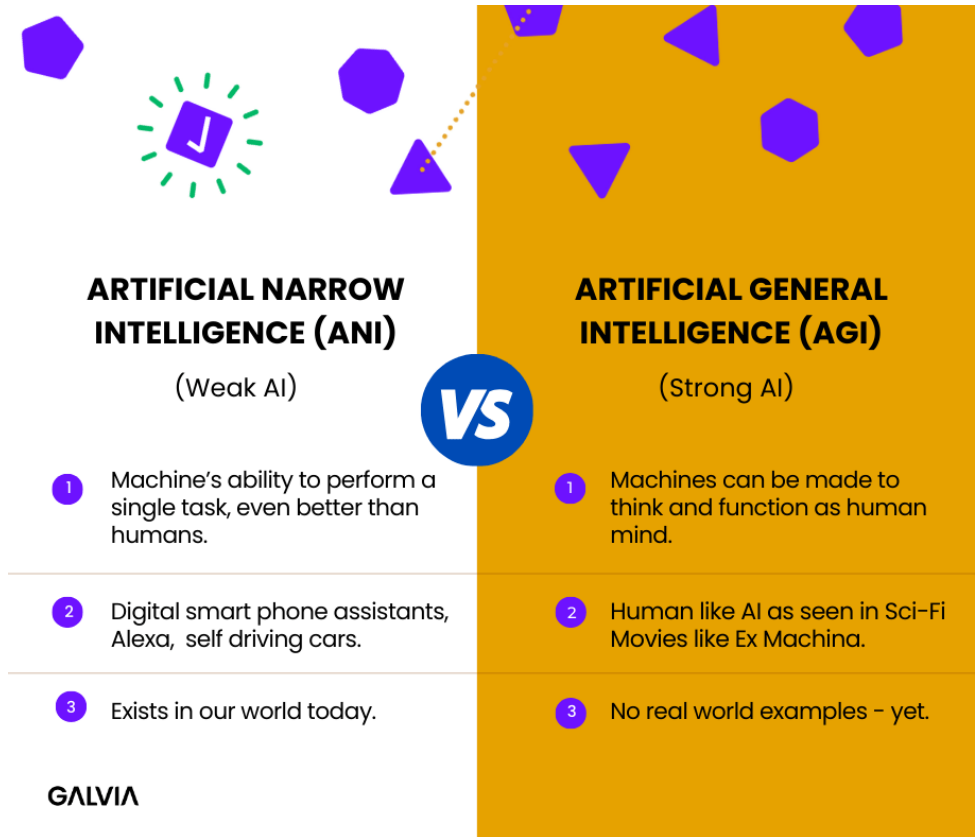
Machines that can assist people without actual human involvement.



Narrow AI versus General AI

Narrow AI systems are designed and trained to perform a particular function and excel at it

General AI systems can understand, learn and perform intellectual tasks like humans but are currently still theoretical

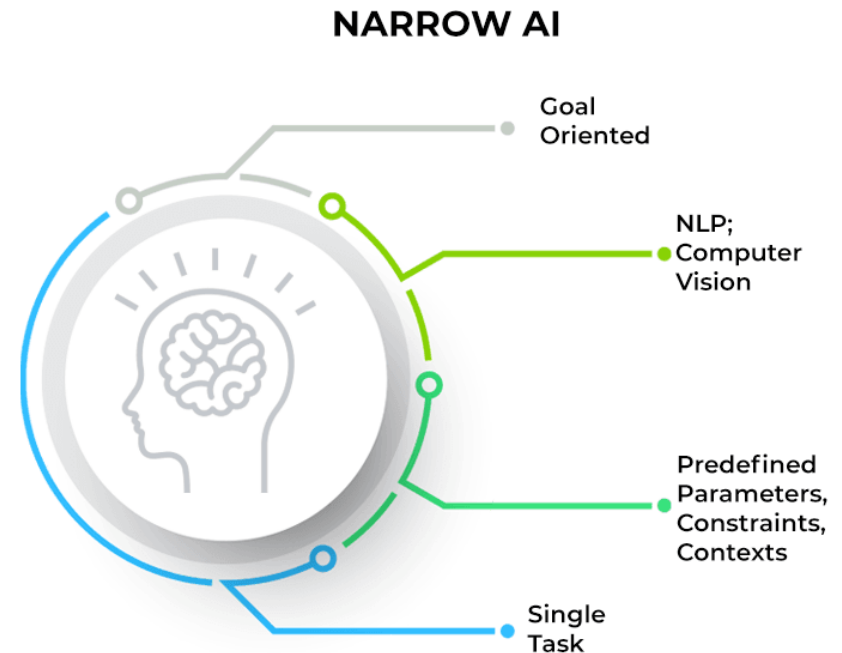


General AI is not yet a reality, so this talk will focus on Narrow AI features relevant to telepharmacy

Narrow AI Described

Narrow AI systems are designed to perform a specific or limited set tasks

- They operate in predefined boundaries
- Optimized to deliver high performance such as solving well-defined problems within a specific domain



Narrow AI systems are extensively trained

- With large datasets
- Using sophisticated algorithms

Machine Learning in AI

Machine Learning allows AI systems to learn patterns from data and make predictions without being explicitly programmed.

ML models improve performance as they are exposed to more data over time using several methods:

- Supervised learning (with labeled data),
- Unsupervised learning (discovering structure)
- Reinforcement learning (trial-and-error optimization)

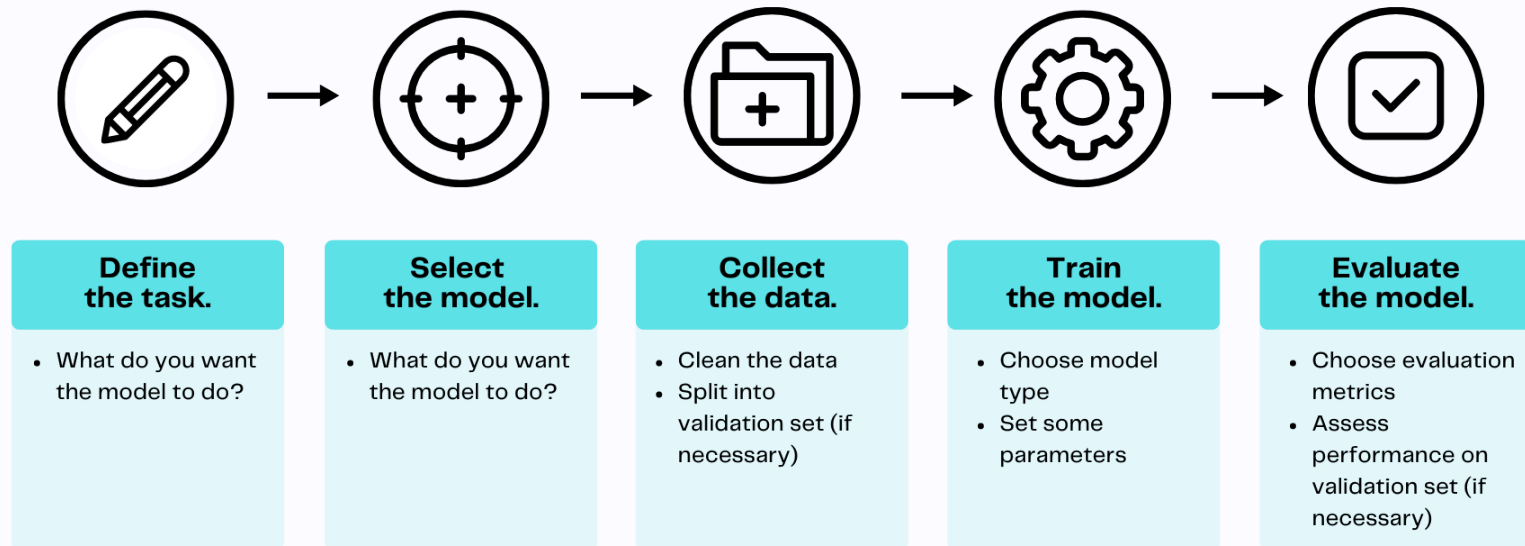
Machine Learning uses **algorithms** like decision trees, support vector machines, and neural networks.

- ML adapts over time, making it useful for predicting outcomes and detecting anomalies

Machine Learning Process Model

Machine learning is an iterative and evolving process

- Focus of interest is centered on the model training step
- Most time is spent on the data collection and cleaning step
- Its adaptability and scalability make it central to AI systems



Machine Learning Pharmacy Example



Machine Learning algorithms help pharmacists analyze large volumes of patient data from labs and EHRs

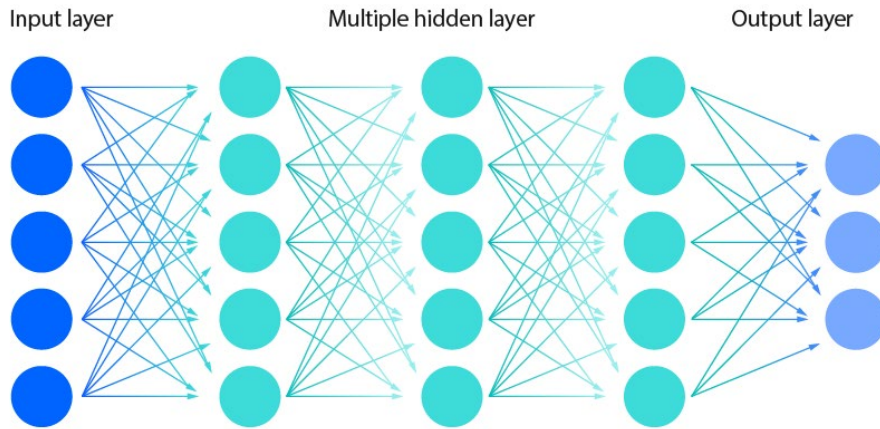
- Identify potential drug-drug interactions
- Assess the safety and efficacy of medicines
- Optimize inventory management by forecasting demand

ML offers promising solutions for predicting and managing adverse drug events

- Can identify patterns linking drugs to specific side effects
- Can analyze diverse information sources to uncover hidden relationships between medications and adverse events.

Neural Networks in AI

Deep neural network

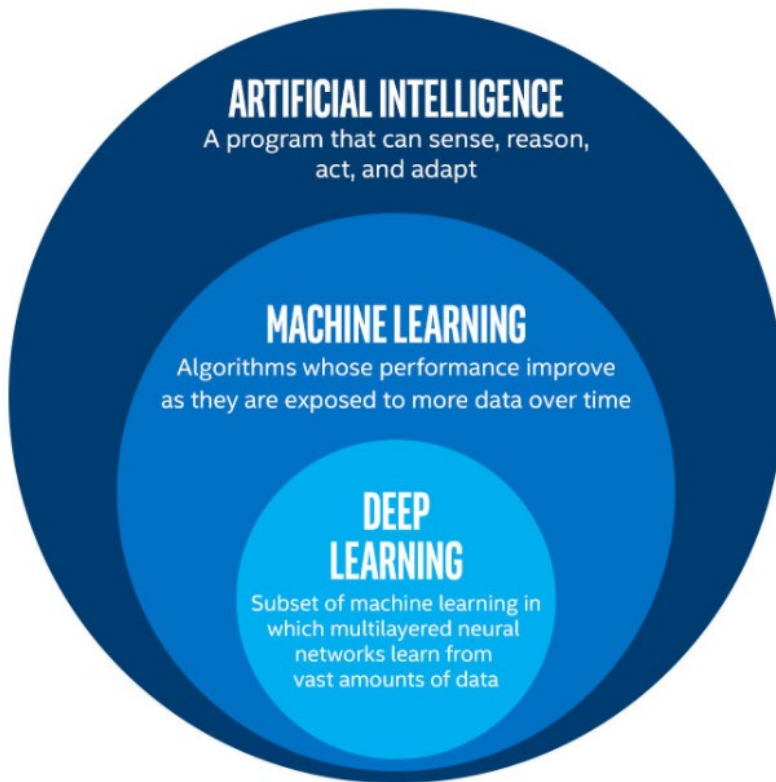


A neural network is an ML model using processes that mimic the way biological neurons work to identify data, weigh options and arrive at conclusions.

Neural networks consist of layers - an input layer, one or more hidden layers, and an output layer.

- When output of any node is above a threshold value, that node is activated and sends data to the next layer

Deep Learning in AI



Deep Learning is a specialized subset of machine learning using neural networks with multiple layers (deep neural nets)

Deep learning models assess raw data and extract relevant output for -

- Image-based diagnostics
- Voice recognition
- Automated note transcription

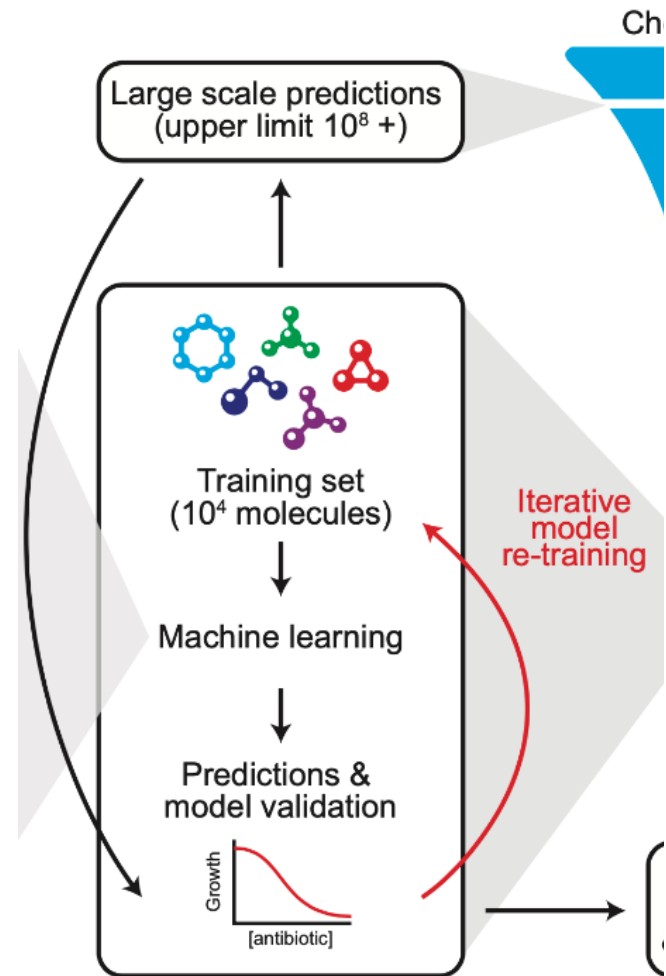
Deep Learning Pharmacy Example

In pharmacy, AI Deep Learning is increasingly used for

- Drug discovery
- Molecular modeling
- Adverse effect prediction

DL algorithms evaluate millions of molecular structures to predict -

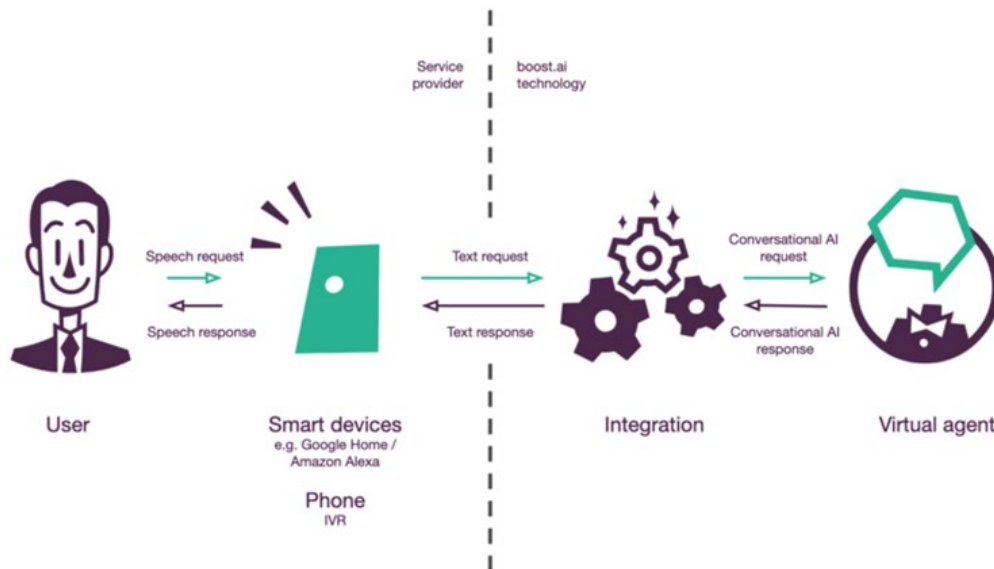
- Therapeutic potential
- Side effects
- Toxicology



AI in Speech Recognition

AI chatbots and conversational assistants convert spoken language into text. They are designed to –

- Understand natural language
- Interpret user queries and provide relevant responses
- Perform specific tasks



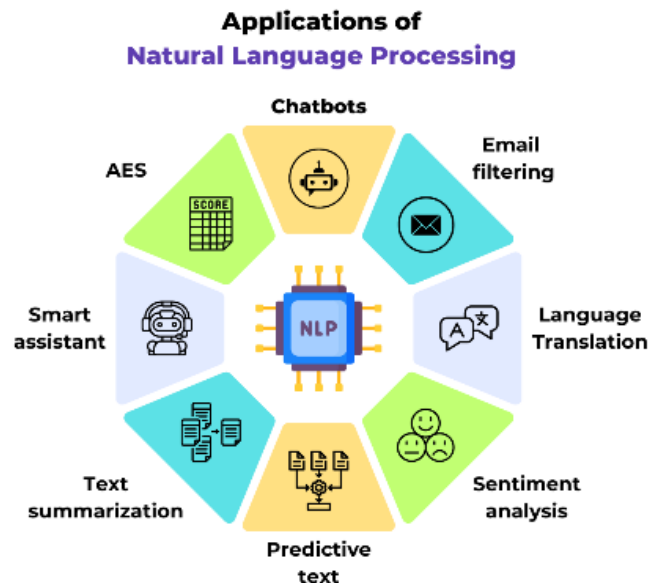
Voice-enabled virtual assistants in telepharmacy enable hands-free interaction and better accessibility for patients

Natural Language Processing

Natural Language Processing uses machine learning to enable computers understand and communicate with human language

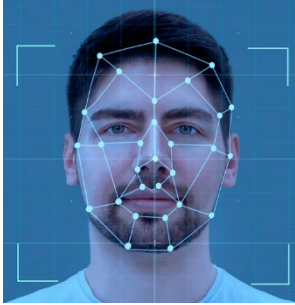
- Apple's Siri, Google's Alexa and Microsoft's Cortana

NLP has enabled the era of Generative AI, from employing large language models (LLMs) to image generation models



NLP combines the power of computational linguistics together with machine learning algorithms and deep learning

Computer Vision & Image Recognition



AI algorithms are used in face and image recognition systems to analyze and identify objects in images or videos

- Consider your cell phone's face recognition capability

Machine Learning utilizes neural network models and deep learning techniques to analyze imaging data for identify clinically significant diagnostic images

- Cancer-related diagnoses
- Histology slides
- Counting and verifying pill labels

Machine Learning is being integrated with Natural Language Processing to explore unstructured data in databases, medical records, lab reports and doctor's notes

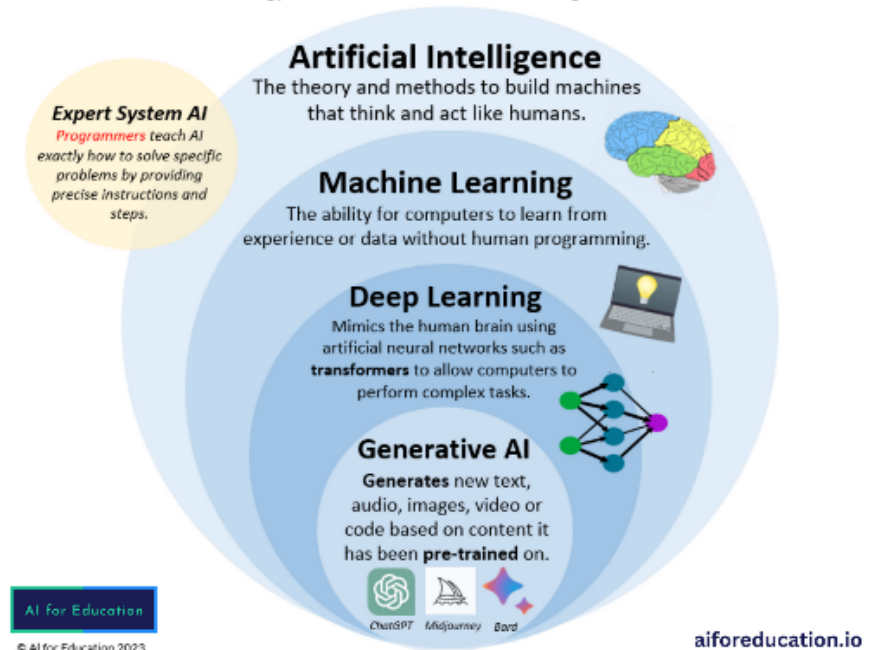
Generative AI

Generative AI (GenAI) creates original content such as text, images, video, audio or software code in response to a user's prompt or request.

GenAI relies on *deep learning* algorithms to simulate the learning and decision-making processes of the human brain

Defining Generative AI

To understand generative artificial intelligence (GenAI), we first need to understand how the technology builds from each of the AI subcategories listed below.



GenAI can understand natural language requests or questions and respond with relevant new content

Chat Room Break

Let's stop here and see if there are any questions in the chat box

Telehealth in Pharmacies Today

Photo taken while picking up medications

A photograph of a pharmacy counter. A blue sign with white text is mounted on the counter. To the right of the sign, a man is visible on a video call screen, looking down. The sign reads:

**Get telehealth care
7 days a week.**

water level indicator.

• Humidifier automatically turns off when low water level

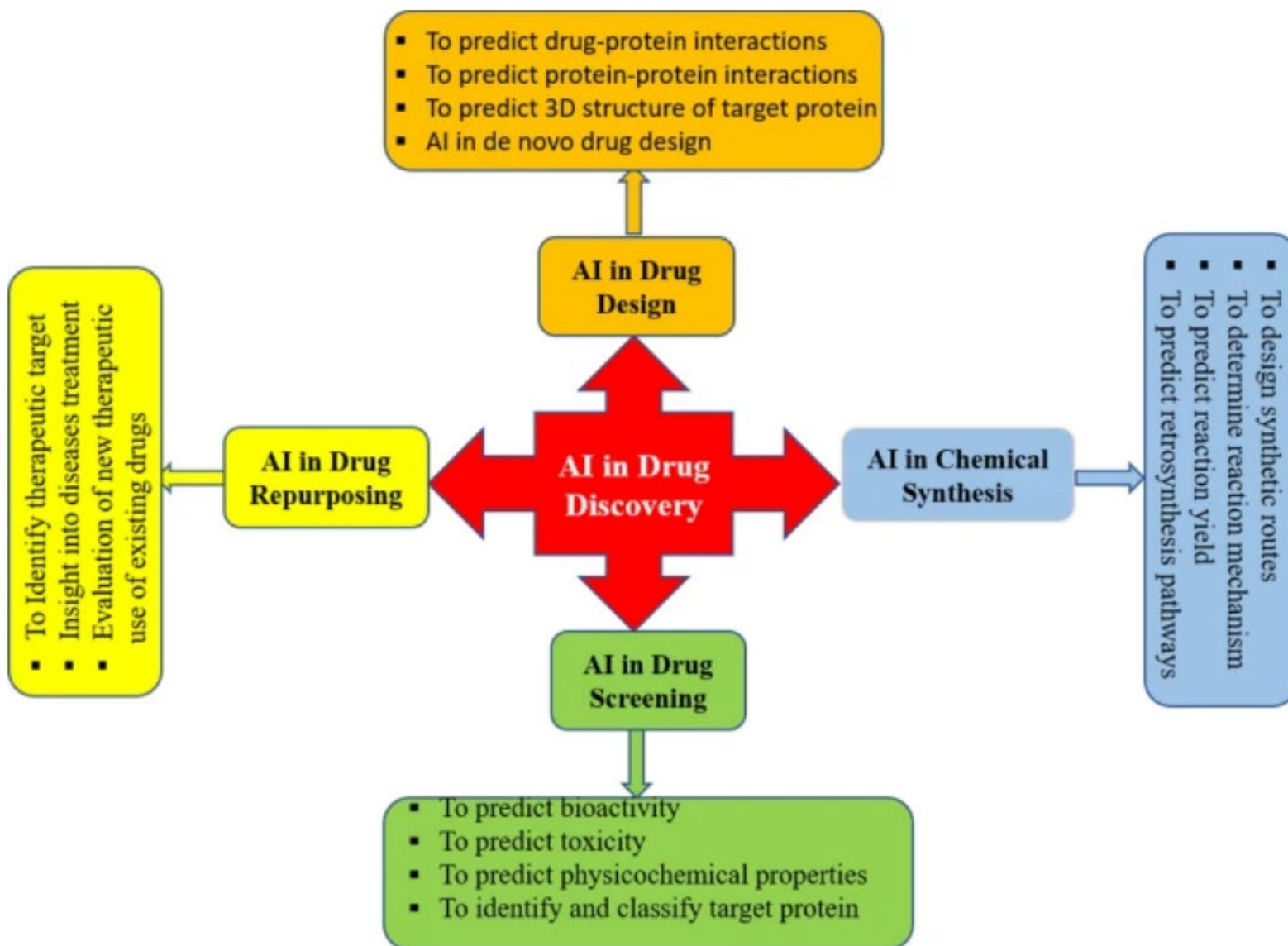
AI in Drug Discovery

AI algorithms have played a pivotal role in AI for drug discovery transforming the drug discovery pipeline by predicting the molecular interactions of potential compounds

- Using deep learning to screen millions of compounds
- Molecular modeling by evaluating billions of molecules quickly to identify optimal ones for synthesis or testing
- Enabling pharmacogenomics and personalized medicine
- Generating optimized molecular structures while matching specific pharmacological and safety profiles

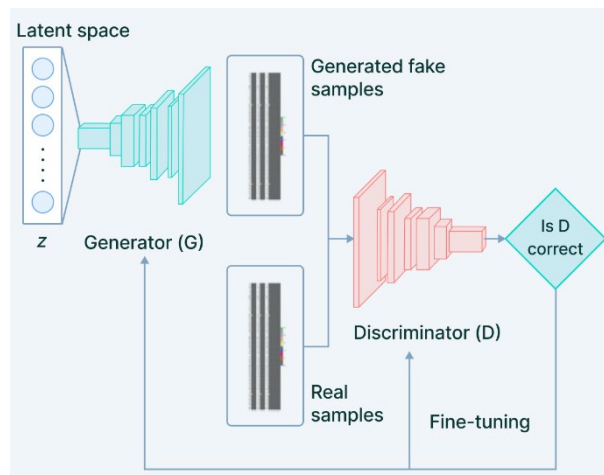
Traditional drug development takes years, but AI accelerates this process using simulation and predictive modeling

AI in Drug Discovery



Generative Adversarial Networks in Drug Development

AI algorithms harness deep learning models and Generative Adversarial Networks to generate new data samples using two neural networks –



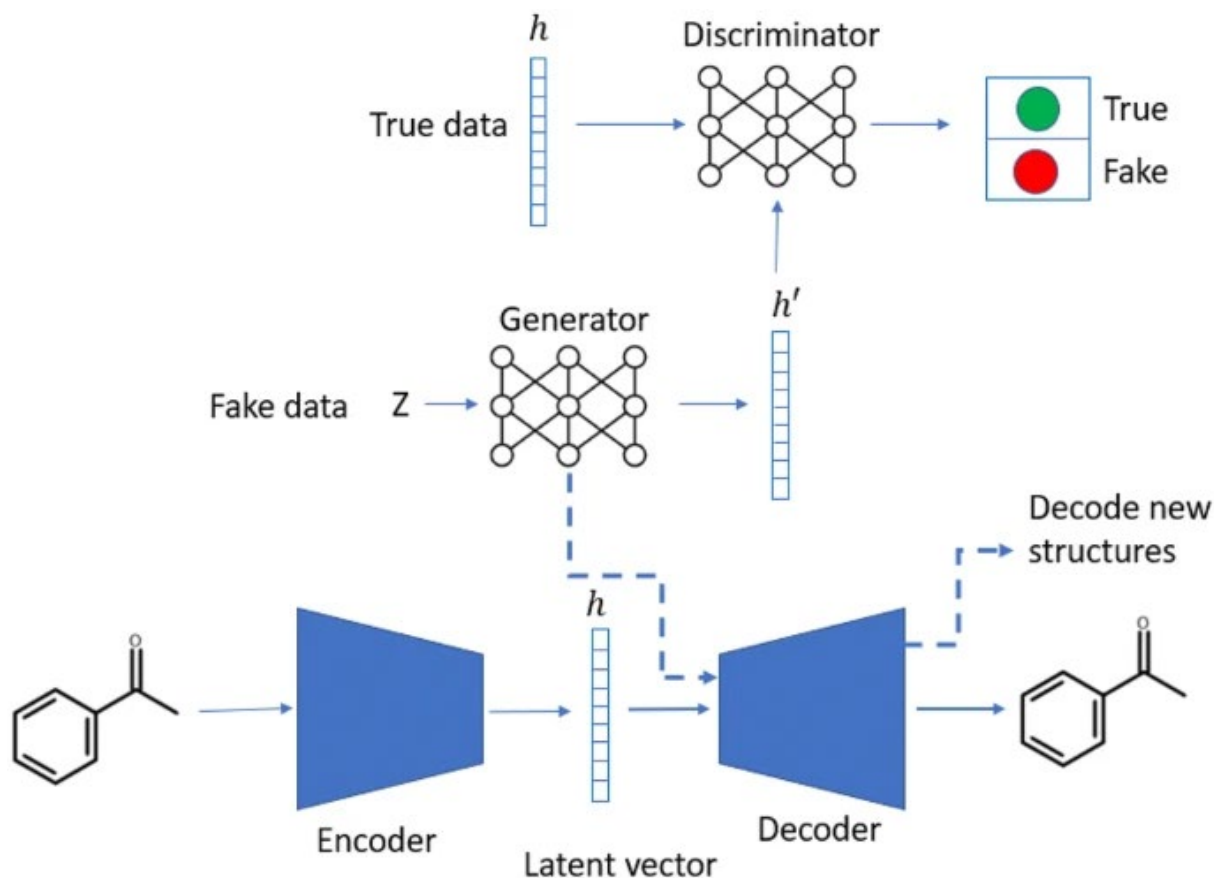
- A **generator** creates new molecular structures that mimic existing compounds with desirable properties
- A **discriminator** evaluates the samples and differentiates the real data from the training set and the fake data created by the generator

This process continues until the generator produces samples that the discriminator can no longer reliably distinguish fake data from real data

Generative Adversarial Network Example

During training,
the generator
neural network
keeps improving
its ability to create
realistic samples

The discriminator
neural network
becomes more
skilled at
detecting fakes



AI Software for Drug Development

AI Software	Key Features
Chemistry42	An AI-driven platform that designs novel molecules for drug discovery using deep learning and reinforcement learning. It generates potential chemical compounds with desired pharmacological properties.
AtomNet (Atomwise)	A deep learning-based structure-based drug design tool that analyzes 3D structures of proteins and predicts molecule-target interactions. Predicts drug-target binding using protein structures.
PandaOmics (Insilico Medicine)	A multinomics AI platform that identifies disease targets using gene expression, epigenetics, and literature mining. It supports hypothesis generation in early research stages.
BioXcel AI Therapeutics Engine	Uses AI to repurpose existing drugs for new indications and designs optimized clinical trial protocols. Machine learning on real-world data and EHRs, drug repurposing and clinical trial optimization.
DeepChem	Provides tools for molecular machine learning, enabling researchers to build custom AI models for cheminformatics and pharmacology.

AI in Pharmacy Inventory Management

AI helps telepharmacy operations manage inventory by predicting medication demand, tracking purchasing trends, automating restocking, preventing shortages or overstocking

- Machine Learning models optimize inventory management by forecasting demand based on seasonal and geographic trends
- This ensures medications are stocked according to need, improving efficiency and patient care outcomes

AI in medical record management enables the automatic organization, extraction and utilization of patient data

- Deep learning models identify relevant clinical information from unstructured notes
- AI also ensures compliance with data handling standards in pharmacy systems

AI in Pharmacy Inventory Management

AI-based analytics tools combine data analysis, machine learning, and predictive analysis to automate supplier management in inventory management

AI-POWERED INVENTORY MANAGEMENT SYSTEM

Smart Cataloging with AI

AI-driven image recognition & NLP auto-classifies products, reducing manual effort



Predictive Demand Forecasting

AI analyzes historical sales patterns & external factors to set optimal stock levels



Automated Inventory Tracking

IoT & AI-powered real-time tracking minimize shrinkage and optimize warehouse logistics



Dynamic Stock Updates

AI-driven inventory adjustments ensure real-time stock accuracy & prevent discrepancies



Data-Driven Insights for Optimization

AI detects trends, seasonal demands & inefficiencies to improve stock planning



AI-Powered Stock Optimization

AI prevents overstocking & stockouts, ensuring smooth operations and cost efficiency



AI Telepharmacy in Clinical Decision Support

Pharmacists play a crucial role in patient-centered care for people with chronic conditions



- AI Telepharmacy can enhance their ability to provide personalized interventions

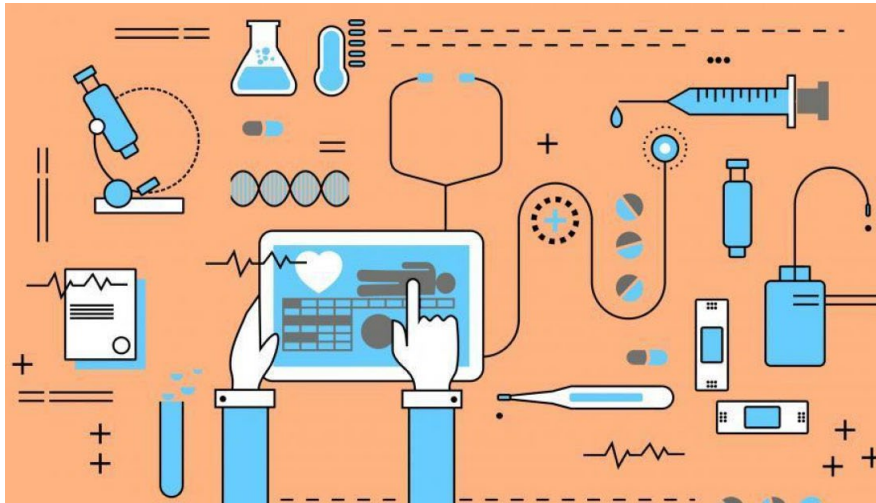
Pharmacists are trained in educating patients to address underlying risks and medication regimen management

- AI-driven Clinical Decision Support Systems analyze patient data, manage chronic diseases and promote adherence to treatment

Telepharmacy services augmented by Machine Learning and AI provide communication channels using AI Telepharmacy chatbots and virtual assistants for chronic diseases requiring continuous monitoring

AI for Medication Therapy Management

AI enhances Medication Therapy Management by helping pharmacists assess drug therapy problems and manage polypharmacy



- AI can examine medication histories, lab values, and patient demographics to optimize therapy plans
- MTM programs powered by AI support more efficient, data-driven pharmacist consultations

- AI tools can be personalized to specific patient populations and conditions

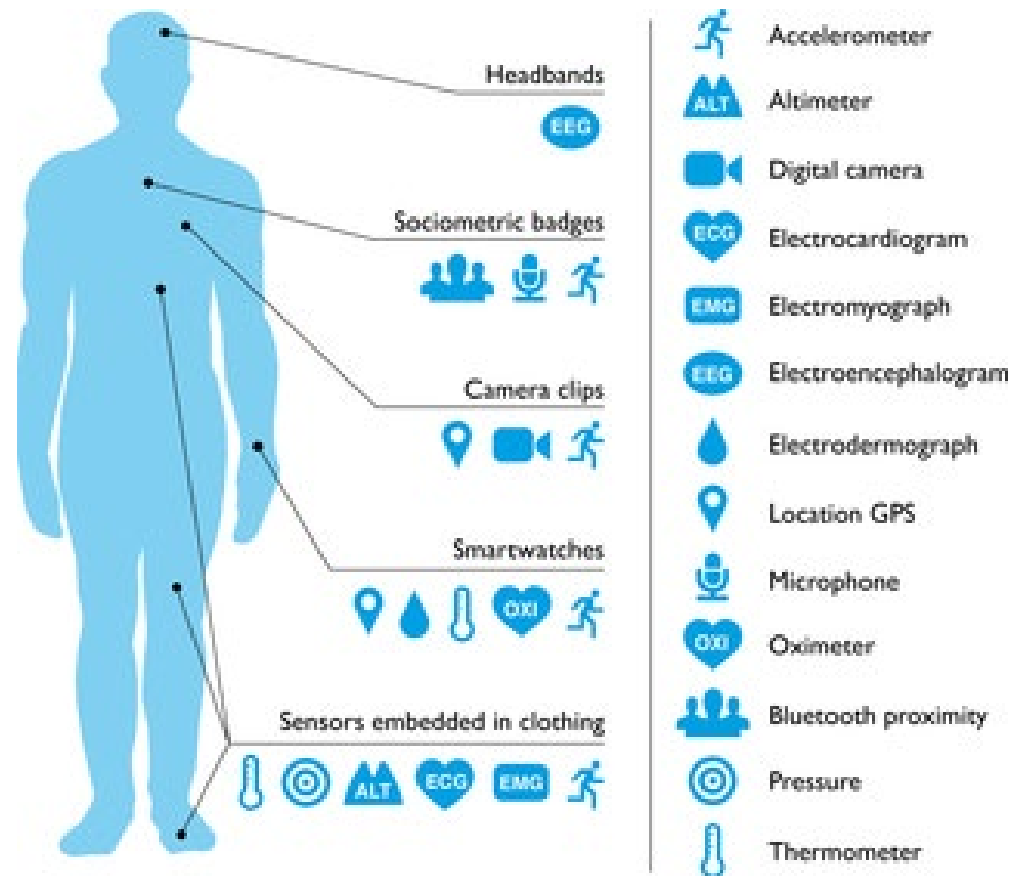
MTM systems improve health outcomes and reduce costs in chronic care settings

AI Telepharmacy in Medication Therapy Management

Telepharmacy enables remote monitoring of patients' medication regimens

Through telemonitoring, pharmacists can

- Track adherence
- Manage adverse events
- Detect drug interactions
- Evaluate therapeutic progress in real time



AI in Telepharmacy

AI-assisted Telepharmacy enables virtual patient education, counseling on medication use and side effects using video or messaging platforms



- Chatbots and virtual assistants help patients with drug information, in understanding medications, symptom triage, and behavior coaching.
- Remote monitoring of medication adherence, side effects and therapy outcomes for chronic disease
- Image recognition software verifies pill authenticity and identity

These tools greatly improve access to pharmacy services

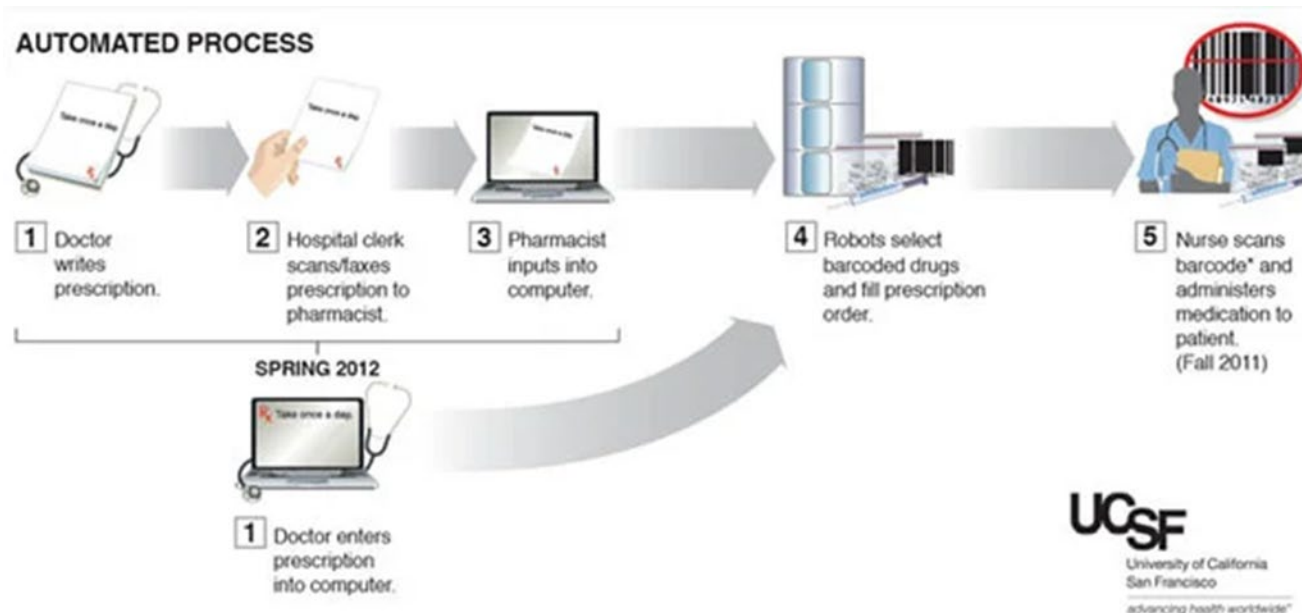
AI Applications in Telepharmacy

Application Area	AI-NLP Feature
Chatbot Interaction	Conversational AI for Q&A, refills, reminders
Virtual Medication Education	Voice assistants for counseling and education
Clinical Documentation	Automated EMR note generation from dialogue
Sentiment & Behavioral Analysis	Detect mood/tone to adapt patient interactions
Multilingual Communication	Translation, speech-to-text, culturally adaptive phrasing

Robotics in Telepharmacy

Robotic dispensing integrates AI with robotic systems for automated medication dispensing and inventory handling

At the University of California San Francisco School of Pharmacy, robots run on embedded AI algorithms for visual inspection, medication scheduling and barcode validation.



Chat Room Break

Let's stop here and see if there are any questions in the chat box

Digital Integration with AI Telepharmacy

Telepharmacy will become deeply intertwined with AI and digital tools in the future. Expect it to transform both clinical and operational workflows in many areas -

- Prescription verification
- Inventory forecasting
- Medication safety checks
- Personalized interventions
- Predictive analytics
- Smart decision-support systems
- AI-driven engagement with chronic disease and polypharmacy patients.



The Future of AI Telepharmacy

Four areas of telepharmacy will most likely merge with AI platforms -

- **Drug therapy monitoring** - Will include real-time adherence tracking, biometric monitoring, and AI-supported alerts for adverse events
- **Patient education** - Will be enhanced with chatbots, mobile apps and video-based learning tools
- **Clinical care coordination** - Will flag drug interactions, or dosing errors using EHR-integrated algorithms that connect pharmacists, physicians and nurses in unified platforms
- **Remote dispensing** - Will be optimized through AI to reach patients at homes, clinics, or partner pharmacies

AI Telepharmacy in Drug Therapy Monitoring

Telepharmacy enables remote monitoring of medication adherence, side effects, and therapy outcomes—especially in chronic disease patients.

- AI tools track adherence and send alerts to patients and providers
- Predictive analytics detect nonadherence patterns and risk of complications

AI enables pharmacists to make data-informed decisions without direct contact, improving outcomes in remote populations

- AI can detect missed doses and provide personalized coaching to improve compliance.
- AI can analyze behavioral data and intervene with reminders, enhancing adherence in chronic disease management.

AI Telepharmacy in Patient Education

Telepharmacy enables virtual patient education, counseling on medication use, and managing side effects via video or messaging platforms available through phone or tablet or computer

- Chatbots and virtual assistants conduct conversations with patients to answer questions, explain prescriptions, remind them of doses, and collect symptom updates
- AI tailors educational content based on patient conditions and behavior

Natural Language Processing enables voice-based systems and virtual assistants to educate patients about medication usage, side effects, and disease-related information.

- Converts written medication instructions into speech
- Allows patients to speak questions and receive real-time answers
- Supports multiple languages and literacy levels

AI Telepharmacy in Remote Dispensing

AI Telepharmacy will help pharmacists verify and approve prescriptions remotely and oversee medication dispensing in rural or spoke sites.

- Image recognition verifies pill authenticity and identity, reducing errors in prescription filling
- AI guarantees the total traceability of the dispensing process
- AI flags discrepancies or wrong medications and enhances accuracy in remote telepharmacy settings without a pharmacist on-site.
- It reduces travels, time and resource use, and facilitates

With increasing demand for healthcare services in rural and remote areas, AI Telepharmacy offers a solution to medication management challenges and improving therapeutic outcomes

AI Telepharmacy in Clinical Care Coordination

NLP tools in telepharmacy platforms will convert verbal consultations into structured pharmacy notes

- Pharmacists can use AI to interpret lab results, monitor health indicators, and recommend changes in therapy
- AI extracts key data from text concerning symptoms, medications, side effects and summarizes patient interactions for review

Pharmacists can provide virtual consultations to adjust therapies, counsel patients, and coordinate care for chronic illnesses

- AI suggests dose modifications based on predictive risk stratification
- Monitors long-term patient outcomes and alerts clinicians to deterioration
- Provides remote verification of best possible medication histories

Telepharmacy AI Enhancements

Telepharmacy Application	AI Feature
Drug Therapy Monitoring	AI adherence tracking and risk alerts. Track missed doses, alerts caregivers.
Image-Based Verification & Dispensing	Image recognition pill validation. Verify pills using AI and computer video.
Patient Counseling & Education	Chatbots, content personalization.
Medication Reconciliation	AI-CDSS flagging interactions, contraindications. Suggest optimal meds based on patient profiles.
Inventory Management	Demand forecasting and automated stock control. Predict demand and prevent stock shortages.
Chronic Care Follow-Up	Predictive analytics for dose adjustments. AI chatbots can provide 24/7 patient support and education.
Clinical Risk Management	Identify high-risk patients for intervention, proactive alerts. Flag interactions, contraindications, dosing issues.
Rural Access	Automated scheduling, refill reminders, consultation and education.

AI Telepharmacy Integrating Digital Health Ecosystems

AI-enhanced telepharmacy will integrate with broader digital health platforms to facilitate multidisciplinary collaboration between pharmacists, nurses, and physicians



- AI will support remote consultations, synchronized with hospital systems, patient portals, and wearables.
- Data from EMRs, smart pill bottles, and biometric sensors will be aggregated and analyzed to guide care plans.

Post-Presentation Questions



Post Presentation Question 1

Hospital pharmacies in the USA introduced AI during COVID to manage drug inventories.

- A. Yes
- B. No
- C. Don't Know

Post Presentation Question 2

Most AI applications today run within the constraints of Narrow AI.

- A. Yes
- B. No
- C. Don't Know

Post Presentation Question 3

The major use of AI in pharmacy today is for drug discovery and development.

- A. Yes
- B. No
- C. Don't Know

Post Presentation Question 4

The merger of AI with Telepharmacy will change the responsibilities of pharmacists in the future.Reimbursement for services.

- A. Yes
- B. No
- C. Don't Know

Thank you for your attention.

Questions?



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Bibliography

1. Abdul Ghani A. AI at the counter: How artificial intelligence is shaping the future of pharmacy practice. Pharmacy Times. Published May 7, 2025. Accessed August 7, 2025. <https://www.pharmacytimes.com/view/ai-at-the-counter-how-artificial-intelligence-is-shaping-the-future-of-pharmacy-practice> Pharmacy Times
2. Abida. Recent advances in artificial intelligence applications in pharmacy practice. Asian J Pharm. 2024. Available from: <https://asiapharmaceutics.info>
3. Adams JL, Law AV, Kawahara B, et al. Report of the 2020-2021 Strategic Engagement Standing Committee. Am J Pharm Educ. 2021;85(10):Article 8715.
4. Admin. Difference between general AI and narrow AI: 2023 guide. Published October 1, 2024. Accessed August 6, 2025. <https://www.parangat.com/difference-between-general-ai-narrow-ai-2023-guide>
5. Almeman A. The digital transformation in pharmacy: Embracing online platforms and the cosmeceutical paradigm shift. J Health Popul Nutr. 2024;43:60. doi:10.1186/s41043-024-00550-2
6. Ambulatory Care Pharmacists Turned to Telehealth. St. John Fisher College Wegmans School of Pharmacy, Rochester NY. [No publication date available].
7. Applications of AI in pharmacy practice: a look at hospital and community settings. [No author]. [No publication date available].
8. Applications of artificial intelligence in current pharmacy practice: a scoping review. PubMed. 2024. Available from: <https://pubmed.ncbi.nlm.nih.gov>
9. Artificial intelligence in community pharmacy practice: pharmacists' perceptions, willingness to utilize, and barriers to implementation. SciDirect. 2024. Available from: <https://sciencedirect.com>
10. Artificial intelligence in pharmacy practice: attitude and willingness of community pharmacists and the barriers for its implementation. SciDirect. 2023. Available from: <https://sciencedirect.com>
11. Artificial intelligence in the field of pharmacy practice: a literature review. SciDirect. 2023. Available from: <https://sciencedirect.com>
12. Awala EV, Olutimehin D. Revolutionizing remote patient care: the role of machine learning and AI in enhancing telepharmacy services. World J Adv Res Rev. 2024;24(3):1133-1149. doi:10.30574/wjarr.2024.24.3.3831
13. Awala EV, Olutimehin D. Revolutionizing remote patient care: The role of machine learning and AI in enhancing telepharmacy services. World J Adv Res Rev. 2024;24(3):1133-1149. doi:10.30574/wjarr.2024.24.3.3831

Bibliography

14. Barker C. Transforming the future: How tech is revolutionizing pharmacy operations in 2025. ColleenLBarker.com. Published 2025. Accessed May 1, 2024. <https://colleenlbarker.com/transforming-the-future-how-tech-is-revolutionizing-pharmacy-operations-in-2025/>
15. Bazzari FH, Bazzari AH. Utilizing ChatGPT in telepharmacy. *Cureus*. 2024;16(1):e52365. doi:10.7759/cureus.52365
16. Benko A, Lányi CS. History of Artificial Intelligence. In: Khosrow-Pour M, editor. *Encyclopedia of Information Science and Technology*. 2nd ed. IGI Global; 2009:4. doi:10.4018/978-1-60566-026-4.ch276
17. Bjork T. Bringing pharmacies back to rural Iowa. Published February 25, 2016. Accessed August 6, 2025. <https://www.iowafarmbureau.com/Article/Bringing-pharmacies-back-to-rural-iowa>
18. Booth H, Souppaya M, Vassilev A, Ogata M, Stanley M, Scarfone K. NIST Special Publication 800-218A: Secure Software Development Practices for Generative AI and Dual-Use Foundation Models—An SSDF Community Profile. National Institute of Standards and Technology; 2024. Accessed August 6, 2025. <https://csrc.nist.gov/publications/detail/sp/800-218a/draft>
19. Bukhari N, Rasheed H, Nayyer B, Babar ZU. Pharmacists at the frontline beating the COVID-19 pandemic. *J Pharm Policy Pract*. 2020;13(1):8. doi:10.1186/s40545-020-00210-w
20. Bukhari N, Rasheed H, Nayyer B, Babar ZU. Pharmacists at the frontline beating the COVID-19 pandemic. *J Pharm Policy Pract*. 2020;13:8. doi:10.1186/s40545-020-00210-w
21. Cantlupe JA. Telehealth Comes Calling. American Association of Colleges of Pharmacy. Published June 7, 2025. Accessed August 3, 2025. <https://www.aacp.org/article/telehealth-comes-calling>
22. Centers for Medicare & Medicaid Services. COVID-19 Frequently Asked Questions (FAQs) on Medicare Fee-for-Service (FFS) Billing. Updated March 31, 2021. Accessed August 6, 2025. <https://www.cms.gov/files/document/03092020-covid-19-faqs-508.pdf>
23. Centers for Medicare & Medicaid Services. Physicians and other clinicians: CMS flexibilities to fight COVID-19. Accessed June 9, 2020. <https://www.cms.gov/files/document/covid-19-physicians-and-practitioners.pdf>
24. Chalasani SH, Syed J, Ramesh M, Patil V, Kumar TMP. Artificial intelligence in the field of pharmacy practice: A literature review. *Explor Res Clin Soc Pharm*. 2023;12:100346. doi:10.1016/j.rcsop.2023.100346
25. Chen RJ, Wang JJ, Williamson DFK, et al. Algorithmic fairness in artificial intelligence for medicine and healthcare. *Nat Biomed Eng*. 2023;7(7):719-742. doi:10.1038/s41551-023-01056-8

Bibliography

26. Chong RLK, Chan ASE, Chua CMS, Lai YF. Telehealth interventions in pharmacy practice: Systematic review of reviews and recommendations [preprint]. JMIR Preprints. February 5, 2024. <https://preprints.jmir.org/preprint/57129>. Accessed May 1, 2024.
27. Como M, Carter CW, Larose-Pierre M, O'Dare K, Hall CR, Mobley J, et al. Pharmacist-led chronic care management for medically underserved rural populations in Florida during the COVID-19 pandemic. *Prev Chronic Dis.* 2020;17:E74. doi:10.5888/pcd17.200265
28. De Gagne JC, Park HK, Hall K, Woodward A, Yamane S, Kim SS. Microlearning in health professions education: scoping review. *JMIR Med Educ.* 2019;5(2):e13997. doi:10.2196/13997
29. DeepMind (Google Health). AI for healthcare. AI for Healthcare Hub. Accessed August 7, 2025. <https://www.aiforhealthcarehub.com/companies/deepmind>
30. Deng J, et al. Artificial intelligence in drug discovery: applications and techniques. arXiv. 2021. Available from: <https://arxiv.org>
31. Deng J, Yang Z, Ojima I, Samaras D, Wang F. Artificial intelligence in drug discovery: applications and techniques. *Brief Bioinform.* 2022;23(1):bbab430. doi:10.1093/bib/bbab430
32. Desai D, Kantliwala S V, Vybhavi J, et al. (July 02, 2024) Review of AlphaFold 3: Transformative Advances in Drug Design and Therapeutics. *Cureus* 16(7): e63646. DOI 10.7759/cureus.63646
33. Development of artificial intelligence powered apps and tools for clinical pharmacy services: a systematic review. PubMed. 2023. Available from: <https://pubmed.ncbi.nlm.nih.gov>
34. DiPiro JT, Hoffmann JM, Tichy EM, et al; ASHP Foundation Pharmacy Forecast Panel. ASHP and ASHP Foundation Pharmacy Forecast 2025: strategic planning guidance for pharmacy departments in hospitals and health systems. *Am J Health Syst Pharm.* 2025;82(2). doi:10.1093/ajhp/zxae280
35. Dragan P, Joshi K, Atzei A, et al. Keras/TensorFlow in drug design for immunity disorders. *Int J Mol Sci.* 2023;24(19):15009. doi:10.3390/ijms241915009
36. Elhaddad M, Hamam S. AI-driven clinical decision support systems: an ongoing pursuit of potential. *Cureus.* 2024;16(4):e57728. doi:10.7759/cureus.57728
37. Elson EC, Oermann CE, Duehlmeier S, Sowell J. Use of telemedicine to provide clinical pharmacy services during the SARS-CoV-2 pandemic. *Am J Health Syst Pharm.* 2020;77(13):1005-1006. doi:10.1093/ajhp/zxaa091

Bibliography

38. Francis M, Francis P, Patanwala AE, Penm J. Obtaining medication histories via telepharmacy: An observational study. *J Pharm Policy Pract.* 2023;16(1):69. doi:10.1186/s40545-023-00573-w
39. Galvia. Preparing your enterprise for the AI-driven future. Accessed August 6, 2025. <https://galvia.ai/blog/preparing-your-sme-for-the-ai-driven-future/>
40. Gilchrist A. CVS Health to integrate IBM's Watson to enhance chronic disease management. *Pharm Times.* 2015;81(10). Available from: <https://www.pharmacytimes.com>
41. Google Cloud. What is artificial intelligence (AI)? Accessed August 6, 2025. <https://cloud.google.com/learn/what-is-artificial-intelligence>
42. Guadamuz JS, Alexander GC, Kanter GP, Qato DM. More US Pharmacies Closed Than Opened In 2018–21; Independent Pharmacies, Those In Black, Latinx Communities Most At Risk. *Health Aff (Millwood).* 2024;43(12). doi:10.1377/hlthaff.2024.00192
43. Haslam C. How AI will reshape pharma in 2025. *DrugTargetReview.com.* Published December 20, 2024. Accessed [date]. <https://www.drugtargetreview.com/article/154981/how-ai-will-reshape-pharma-by-2025/>
44. Hatzimanolis J, Riley B, El-Den S, Aslani P, Zhou J, Chaar B. Applications of artificial intelligence in current pharmacy practice: a scoping review. *Res Social Adm Pharm.* 2025;21(3):134-141. doi:10.1016/j.sapharm.2024.12.007
45. Hedima EW, Adeyemi MS, Ikunaiye NY. Community Pharmacists: On the frontline of health service against COVID-19 in LMICs. *Res Social Adm Pharm.* 2021;17(1):1964-1966. doi:10.1016/j.sapharm.2020.04.013
46. Holdsworth J, Scapicchio M. What is deep learning? *IBM Think.* Published June 17, 2024. Accessed August 7, 2025. <https://www.ibm.com/think/topics/deep-learning>
47. Hron JD, Payvandi L, Parsons CR, Bourgeois FC. A Year of Inpatient Telehealth: Lessons From the COVID-19 Pandemic. *Hosp Pediatr.* 2023. doi:10.1542/hpeds.2022-007009
48. IBM Data and AI Team. What is a neural network? *IBM Think.* Published [no date]. Accessed August 7, 2025. <https://www.ibm.com/think/topics/neural-networks>
49. IBM Think. Artificial intelligence in medicine. *IBM.* 2021 Aug 4. Available from: <https://www.ibm.com/think/topics/artificial-intelligence-medicine>
50. IBM Think. Artificial intelligence in medicine. *IBM.* 2021 Aug 4. Available from: <https://www.ibm.com/think/topics/artificial-intelligence-medicine>

Bibliography

51. IBM Watson Health and OrbitalRX to Launch Integrated Solution to Assist Hospital Pharmacy Providers in Managing Drug Shortages. PR Newswire. Published Sept 1, 2020. Accessed August 3, 2025. <https://www.prnewswire.com/news-releases/ibm-watson-health-and-orbitalrx-to-launch-integrated-solution-to-assist-hospital-pharmacy-providers-in-managing-drug-shortages-301124842.html>
52. IBM Watson Health; OrbitalRX. IBM Watson Health (now Merative) and OrbitalRX to launch integrated solution to assist hospitals manage drug shortages. Accessed August 6, 2025. <https://orbitalrx.com/ibm-and-orbitalrx-launch-integrated-drug-shortage-management-solution/>
53. IBM. What is artificial intelligence in medicine? IBM Think. Published August 4, 2021. <https://www.ibm.com/think/topics/artificial-intelligence-medicine>
54. Idrissi YS. IBM Watson: pioneering AI for a transformative future. IBM Community Blog. Published August 17, 2023. <https://community.ibm.com/community/user/blogs/youssef-sbai-idrissi1/2023/08/17/ibm-watson-pioneering-ai-for-a-transformative-futu>
55. Idrissi YS. IBM Watson: pioneering AI for a transformative future. IBM Community Blogs. 2023 Aug 17. Available from: <https://community.ibm.com/community/user/blogs/youssef-sbai-idrissi1/2023/08/17/ibm-watson-pioneering-ai-for-a-transformative-futu>
56. Ilkic J, Milovanovic M, Marinkovic V. Prospective systematic risk analysis of the digital technology use within pharmaceutical care. J Am Pharm Assoc. 2024;64:102081. doi:10.1016/j.japh.2023.102081
57. Jarab AS, Al-Qerem W, Alzoubi KH, et al. Artificial intelligence in pharmacy practice: attitude and willingness of community pharmacists and the barriers for its implementation. Saudi Pharm J. [published online ahead of print January 15, 2025]. doi:[not available]
58. Kaul V, Enslin S, Gross SA. History of artificial intelligence in medicine. Gastrointest Endosc. 2020;92(4):807. doi:10.1016/j.gie.2020.06.040
59. Kaul V, Enslin S, Gross SA. History of artificial intelligence in medicine. Gastrointest Endosc. 2020;92(4):807–812. doi:10.1016/j.gie.2020.06.040
60. Kenny K. Artificial intelligence has implications for medication safety. Pharmacy Times. Published March 18, 2025;91(3). Accessed August 7, 2025. <https://www.pharmacytimes.com/view/ai-at-the-counter-how-artificial-intelligence-is-shaping-the-future-of-pharmacy-practice>
61. Khuman SM, Raval MM, Bilakhia SG, Shroff RS. Role of artificial intelligence in field of pharmacy. In: Emerging Pharmaceutical Science: Today & Tomorrow. 2024. p. 21. ISBN 978-93-6252-484-3.

Bibliography

62. Kundu S. AI in medicine must be explainable. *Nat Med*. 2021;27:1328. doi:10.1038/s41591-021-01461-z
63. Lazaro E, Ullrich F, Mueller KJ. Update on Rural Independently Owned Pharmacy Closures in the United States, 2003–2021. RUPRI Center for Rural Health Policy Analysis; 2022. Brief No. 2022-3. Accessed August 3, 2025. <http://www.public-health.uiowa.edu/rupri/>
64. Legal Information Institute, Cornell Law School. Artificial intelligence (AI). Accessed August 6, 2025. [https://www.law.cornell.edu/wex/artificial_intelligence_\(ai\)](https://www.law.cornell.edu/wex/artificial_intelligence_(ai))
65. Liu Z, et al. PharmacyGPT: the AI pharmacist. *arXiv*. 2023. Available from: <https://arxiv.org>
66. Liu Z, Wu Z, Hu M, et al. PharmacyGPT: the artificial intelligence pharmacist and an exploration of AI for ICU pharmacotherapy management. Preprint. *arXiv*:2307.10432v3. Published October 3, 2024.
67. Mandal S, Wiesenfeld BM. The “New” New Normal: Changes in Telemedicine Utilization Since COVID-19. *Am J Manag Care*. 2025;31(3):e74-e78.
68. McCarthy D, Nuzum R, Mika S, Wrenn J, Wakefield M. The North Dakota Experience: Achieving High-Performance Health Care Through Rural Innovation and Cooperation. The Commonwealth Fund; May 2008. Accessed August 6, 2025. <https://core.ac.uk/download/71353481.pdf>
69. McCulloch WS, Pitts W. A logical calculus of the ideas immanent in nervous activity. *Bull Math Biophys*. 1943;5:115–133.
70. Meng L, Fu J. Application of artificial intelligence technology in clinical pharmacy. *IOP Conf Ser Mater Sci Eng*. 2020. Available from: <https://iopscience.iop.org>
71. Morillo-Verdugo R, Collado-Borell R, Arrondo-Velasco A, Domínguez-Cantero M, Fernández-Polo A, González-Corominas E, et al. Implementation of pharmaceutical care through Telepharmacy: A guide for professionals and patients. *Farm Hosp*. 2022;46(Suppl 1):S115-S122. doi:10.7399/fh.13260
72. Motley Fool Staff. What is artificial intelligence? Published February 25, 2025. Accessed August 6, 2025. <https://www.fool.com/terms/a/artificial-intelligence/>
73. National Aeronautics and Space Administration (NASA). Defining artificial intelligence. Accessed August 6, 2025. <https://www.nasa.gov/what-is-artificial-intelligence/>
74. National Association of Boards of Pharmacy. Report of the Task Force on the Regulation of Telepharmacy Practice: Model State Pharmacy Act. Accessed August 6, 2025. https://nabp.pharmacy/wp-content/uploads/2017/05/2016_2017_TelepharmacyTF_Report.pdf

Bibliography

75. National Institute of Standards and Technology. Artificial intelligence. Accessed August 6, 2025. https://csrc.nist.gov/glossary/term/artificial_intelligence
76. Navazi F, Yuan Y, Archer N. A review of big data analytics models for assessing non-pharmaceutical interventions for COVID-19 pandemic management. *Hum Vaccin Immunother*. 2024;20(3):358-388. doi:10.1080/23270012.2024.2372632
77. Navazi F, Yuan Y, Archer N. A review of big data analytics models for assessing non-pharmaceutical interventions for COVID-19 pandemic management. *J Big Data Health*. 2024. doi:10.1080/23270012.2024.2372632
78. Negnevitsky M. The history of artificial intelligence or from the "Dark Ages" to the knowledge-based systems. *Trans Inf Commun Technol*. 1997;19. WIT Press. Available from: <https://www.witpress.com>
79. Newhauser M. What is generative AI? A comprehensive guide for everyone. Published June 26, 2023. Accessed August 7, 2025. <https://www.gptechblog.com/what-is-generative-ai-comprehensive-guide-beginners/>
80. Newhauser M. What is generative AI? A comprehensive guide for everyone. Published June 26, 2023. Accessed August 7, 2025. <https://www.gptechblog.com/what-is-generative-ai-comprehensive-guide-beginners/>
81. Newhauser, M. Five Diagrams to Understand AI. Accessed August 6, 2025. <https://www.gptechblog.com/5-diagrams-to-help-you-understand-generative-ai/>
82. Nowosielski B, Nelson S. The current, future roles of AI within the pharmacy profession. [Online]. Published February 27, 2025. <https://www.drugtopics.com/view/development-of-ai-is-essential-to-pharmacy-education> *(duplicate URL—exact source to be confirmed)*
83. Nowosielski B. Development of AI is essential to pharmacy education. *Drug Topics*. Published May 28, 2025. <https://www.drugtopics.com/view/development-of-ai-is-essential-to-pharmacy-education>
84. Okoro RN. Telepharmacy and digital pharmaceutical services in the era of COVID-19: A scoping review. *Pharm Pract (Granada)*. 2021;19(4):2250. doi:10.18549/PharmPract.2021.4.2250
85. Pathak S, Haynes M, Qato DM, Urick BY. Telepharmacy and quality of medication use in rural areas, 2013–2019. *Prev Chronic Dis*. 2020;17:200012. doi:10.5888/pcd17.200012
86. Pathak S, Haynes M, Qato DM, Urick BY. Telepharmacy and Quality of Medication Use in Rural Areas, 2013–2019. *Prev Chronic Dis*. 2020;17:E101. doi:10.5888/pcd17.200094
87. Peterson CD. ND Telepharmacy Project. North Dakota State University College of Health Professions. Accessed August 6, 2025. <https://www.ndsu.edu/telepharmacy/>

Bibliography

88. Pharmacy Talk with IBM Watson Health. Demystifying the use of AI in pharmacy. Pharmacy Podcast Network. 2021 Sep 9. Available from: <https://pharmacypodcastnetwork.podbean.com/e/demystifying-the-use-of-ai-in-pharmacy-pharmacy-talk-with-ibm-watson-health/>
89. Pharmacy Talk with IBM Watson Health. Demystifying the use of AI in pharmacy. Pharmacypodcastnetwork.podbean.com. Published September 9, 2021. <https://pharmacypodcastnetwork.podbean.com/e/demystifying-the-use-of-ai-in-pharmacy-pharmacy-talk-with-ibm-watson-health/>
90. Pharmacy Times. AI at the Counter: How Artificial Intelligence Is Shaping the Future of Pharmacy Practice. Published May 7, 2025. Accessed [date]. <https://www.pharmacytimes.com/view/ai-at-the-counter-how-artificial-intelligence-is-shaping-the-future-of-pharmacy-practice>
91. Pharmacy Today. Innovations. Pharmacy Today. 2020;26(8):26-29. Accessed August 6, 2025. <https://www.pharmacytoday.org/action/showPdf?pii=S1042-0991%2820%2930756-8>
92. Porter AL, Frenzel JE, Siodlak MM. Assessment of a two-school collaborative telepharmacy simulation. Curr Pharm Teach Learn. Published December 28, 2021. doi:10.1016/j.cptl.2021.11.020
93. Powles J, Hodson H. Google DeepMind and healthcare in an age of algorithms. Health Technol (Berl). 2017;7(4):351–367. doi:10.1007/s12553-017-0179-1
94. Pritchard RI, Huff J, Scheinberg N. Impact of regulatory changes on pharmacist-delivered telehealth during the COVID-19 pandemic. J Am Pharm Assoc (2003). 2020;60(5):e76-e79. doi:10.1016/j.japh.2020.06.004
95. Prykhodko, O., Johansson, S.V., Kotsias, PC. et al. A de novo molecular generation method using latent vector based generative adversarial network. J Cheminform 11, 74 (2019). <https://doi.org/10.1186/s13321-019-0397-9>
96. Rabbani SA, Sharma S, Mahtab A, Pot FH. A systematic scoping review of implementation of telepharmacy during COVID-19. J Appl Pharm Sci. 2023;13(4):30-44. doi:10.7324/JAPS.2023.113646
97. Rammal DS, Alomar M, Palaian S. AI-Driven pharmacy practice: unleashing the revolutionary potential in medication management, pharmacy workflow, and patient care. Pharmacy Pract. 2024;22(2):2958. doi:10.18549/PharmPract.2024.2.2958
98. Ranchon F, Chanoine S, Lambert-Lacroix S, et al. Development of artificial intelligence powered apps and tools for clinical pharmacy services: a systematic review. Int J Med Inform. 2023;172:104983. doi:10.1016/j.ijmedinf.2022.104983

Bibliography

88. Raza MA, Aziz S, Noreen M, et al. Artificial intelligence (AI) in pharmacy: an overview of innovations. *Innov Pharm.* 2022;13(2):Article 13. doi:10.24926/iip.v13i2.4839
89. Research and Markets. Artificial Intelligence in Drug Discovery Market Outlook Report 2025-2030: Accelerating Drug Discovery as Pharma Embraces Machine Learning and Data-Driven Innovations. Published May 8, 2025. Accessed [date]. <https://www.globenewswire.com/news-release/2025/5/8/3076995/28124/en/Artificial-Intelligence-in-Drug-Discovery-Market-Outlook-Report-2025-2030-Accelerating-Drug-Discovery-as-Pharma-Embraces-Machine-Learning-and-Data-Driven-Innovations.html>
90. Reyna MA, Nsoesie EO, Clifford GD. Rethinking algorithm performance metrics for artificial intelligence in diagnostic medicine. *JAMA.* 2022;328(4):329-330. doi:10.1001/jama.2022.10561
91. Rural Health Research Gateway. Changes in rural pharmacy presence 2023. Published August 8, 2024. Accessed August 8, 2025. https://rupri.public-health.uiowa.edu/publications/policybriefs/2024/Rural_Pharmacy_Presence.pdf
92. Sendekie AK, Limenh LW, Abate BB, et al. Artificial intelligence in community pharmacy practice: Pharmacists' perceptions, willingness to utilize, and barriers to implementation. *Explor Res Clin Soc Pharm.* 2024;16:100542. doi:10.1016/j.rcsop.2024.100542
93. Shete M, Shete A. AI-driven pharmacy practice: unleashing the revolutionary potential in medication management, pharmacy workflow, and patient care. *Pharm Pract.* 2022. Available from: <https://pharmacypractice.org>
94. Simpson MD, Qasim HS. Clinical and operational applications of artificial intelligence and machine learning in pharmacy: a narrative review of real-world applications. *MDPI.* 2025. Available from: <https://mdpi.com>
95. Simpson MD, Qasim HS. Clinical and operational applications of artificial intelligence and machine learning in pharmacy: a narrative review of real-world applications. *Pharmacy (Basel).* 2025;13(2):41. doi:10.3390/pharmacy13020041
96. Straw A. Telehealth – an opportunity to expand pharmacist services in primary care. Published November 20, 2020. Accessed August 6, 2025.
97. Stryker C, Holdsworth J. What is NLP (natural language processing)? IBM Think. Published August 11, 2024. Accessed August 7, 2025. <https://www.ibm.com/think/topics/natural-language-processing> IBM
98. Stryker C, Kavlakoglu E. What is AI? IBM. Accessed August 6, 2025. <https://www.ibm.com/think/topics/artificial-intelligence>
99. TechVidvan Team. Top 7 artificial intelligence characteristics with examples. TechVidvan. <https://techvidvan.com/tutorials/artificial-intelligence-features/>. Accessed August 5, 2025.

Bibliography

100. Thabit AK, Jose J. Challenges and opportunities of clinical pharmacists during COVID-19: A review of the literature. Pharmacy Practice Department, Faculty of Pharmacy, King Abdulaziz University; School of Pharmacy, University of Nizwa. Published July 5, 2022.
101. The growing practice of telepharmacy. Elite Learning. Accessed May 1, 2024. <https://www.elitelearning.com/resource-center/pharmacy-2/the-growing-practice-of-telepharmacy/>
102. Thompson D. Almost a Third of U.S. Retail Pharmacies Have Closed Since 2010. HealthDay. Published December 4, 2024. Accessed August 3, 2025. <https://www.healthday.com>
103. Tignor K, Schalliol L, Glover A. Artificial intelligence and the future of specialty pharmacy. US Pharm. 2025;50(1):29-32. <https://www.uspharmacist.com/article/artificial-intelligence-and-the-future-of-specialty-pharmacy>
104. Traynor K. AI helps pharmacists streamline routine tasks. ASHP News Center. Published April 8, 2025. <https://www.ashp.org/news> *(URL pending)*
105. Traynor K. Pharmacists respond to COVID-19 pandemic. Am J Health Syst Pharm. 2020;77(9):662-665. doi:10.1093/ajhp/zxaa069
106. Truong VD, Tu VL, Quan NK, et al. Telepharmacy: a systematic review of field application, benefits, limitations, and applicability during the COVID-19 pandemic. Telemed J E Health. 2023;29(2):[pages]. doi:10.1089/tmj.2021.0575
107. Tucker J. 2023 State-by-State Telepharmacy Regulation Analysis White Paper. TelePharm. Accessed August 6, 2025. <https://blog.telepharm.com/state-by-state-telepharmacy-regulation-analysis-2023>
108. Ullrich F, Mueller K. Changes in Rural Pharmacy Presence 2023. RUPRI Center for Rural Health Policy Analysis; 2024. Brief No. 2024-4 (Revised 2/27/2025). Accessed August 3, 2025. <https://rupri.public-health.uiowa.edu>
109. Ullrich F, Mueller K. Pharmacy Vaccination Service Availability in Nonmetropolitan Counties (V3). RUPRI Center for Rural Health Policy Analysis; 2021. Brief No. 2020-10. Accessed August 3, 2025. <http://www.public-health.uiowa.edu/rupri/>
110. Umar AK, Limpikirati P, Zothantluanga JH, Shumkova MM, Prosvirkin G, Luckanagul JA. Telepharmacy: A modern solution for expanding access to pharmacy services. In: Artificial Intelligence, Big Data, Blockchain and 5G for the Digital Transformation of the Healthcare Industry. Elsevier; 2024:125-145. doi:10.1016/B978-0-443-21598-8.00009-9
111. USC Schaeffer. Nearly 1 in 3 Retail Pharmacies Have Closed Since 2010, Widening Health Disparities. University of Southern California. Published December 3, 2024. Accessed August 3, 2025. <https://healthpolicy.usc.edu>

Bibliography

112. Viegas R, Dineen-Griffin S, Söderlund LA, Acosta-Gómez J, Guiu JM. Telepharmacy and pharmaceutical care: A narrative review by International Pharmaceutical Federation. *Farm Hosp.* 2022;46(Suppl 1):S86-S91.
113. Vogler S. Tackling medicine shortages during and after the COVID-19 pandemic: compilation of governmental policy measures and developments in 38 countries. *Health Policy.* 2024;[volume(issue)]:[pages]. doi:[pending]
114. Yeo G. Artificial intelligence and the future(s) of archival theory and practice. *Archeion.* 2024;125:10-32.