How Artificial Intelligence is Transforming Cancer Care: Essential Insights for Oncology Pharmacists

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DIRECTIONS IN Oncology Pharmacy

PTce ONCOLOGY

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This activity is approved for 1.0 contact hour (0.10 CEU) under the ACPE universal activity number 0290-0000-24-259-L99-P.

Release Date: October 19, 2024

Activity Type: Application

Fee: Free

This activity is supported by an educational grant from Ipsen Biopharmaceuticals, Inc.

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Educational Objectives

After completion of this activity, participants will be able to:

- Explore the clinical application of artificial intelligence (AI) in oncology and its impact on patient outcomes
- Analyze data demonstrating the safety and efficacy of AI in cancer prognosis and clinical decision-making
- Explain the benefits, challenges, and ethical considerations of AI in oncology care

Pretest Questions

Pretest Question 1

Which of the following is a current clinical application of artificial intelligence (AI) in oncology care?

A. Predicting patient adherence to oral chemotherapy
B. Enhancing image analysis for early cancer detection
C. Automating chemotherapy dosing adjustments
D. Recommending lifestyle changes for cancer prevention

Pretest Question 2

Which of the following best describes the role of AI in improving the accuracy of cancer prognosis?

A. Provides predictions solely based on genetic information
B. Integrates various data sources to offer personalized prognostic insights
C. Replaces the need for traditional prognostic tools
D. Focuses predictions on short-term survival rates and quality of life

Pretest Question 3

You are on a committee to oversee the rollout of a new patient care tool that will integrate with your electronic health record to help guide medication dosing for patients receiving cancer treatment. Which of the following points would be appropriate to consider regarding the ethical use of this product?

A. Cost to license product
B. Training required to utilize the software
C. Patient data used to train the model
D. Liability of using the product

Pretest Question 4

Before participating in this activity, how knowledgeable are you in the use of artificial intelligence in cancer care?

A. Not at all
B. Somewhat
C. Moderately
D. Very
E. Extremely

WHY USE ARTIFICIAL INTELLIGENCE (AI)?

- Saves time spent on monotonous work and redundant activities
- Allows further scalability and improvement on labor from "self-learning"
- Leverages automation in certain activities with limited oversight

THE ANTIKYTHERA

- Oldest known analogue computer
- Created between 150 to 100 BC
- Used to predict astronomical occurrences and solar eclipses

Common AI Terminology

Machine Learning (ML): training on data to make predictions

Generative AI (GenAI): AI capable of creating text, images, and code

Hallucinations: GenAI creates content that is false

Bias: models lack enough data and make poor predictions

Large Language Models (LLM): AI model that can generate natural language text

Diffusion Models: AI that can be used to create images from text

Foundation Models: AI model that was trained on immense data and can do multiple actions

Natural Language Processing (NLP): ability for AI to understand human language

Inference: how GenAI can predict what is "best" to create

Tokens: chunks of data (text) that AI uses to analyze and generate actions

Neural Network: the architecture that helps AI process data (think human neurons)

Transformer: a neural network that uses a mechanism to understand how items relate to each other

Retrieval-Augmented Generation (RAG): ability to help a GenAI to focus on other materials and context

Artificial General Intelligence (AGI): an AI that is essentially superintelligent (*2001: A Space Odyssey*)

Parameters: how AI takes data and converts to an output through mathematical techniques

The Verge. July 22, 2024. Accessed October 16, 2024. https://www.theverge.com/24201441/ai-terminology-explained-humans

- Comes to prominence in the 1950s through the 1980s
- Primarily simple tasks that take advantage of “if-then” logic engines
    - Making human logic fit a system of rules
- Development of different fields of AI focused on different models with varying levels of logic and training

SYMBOLIC AI

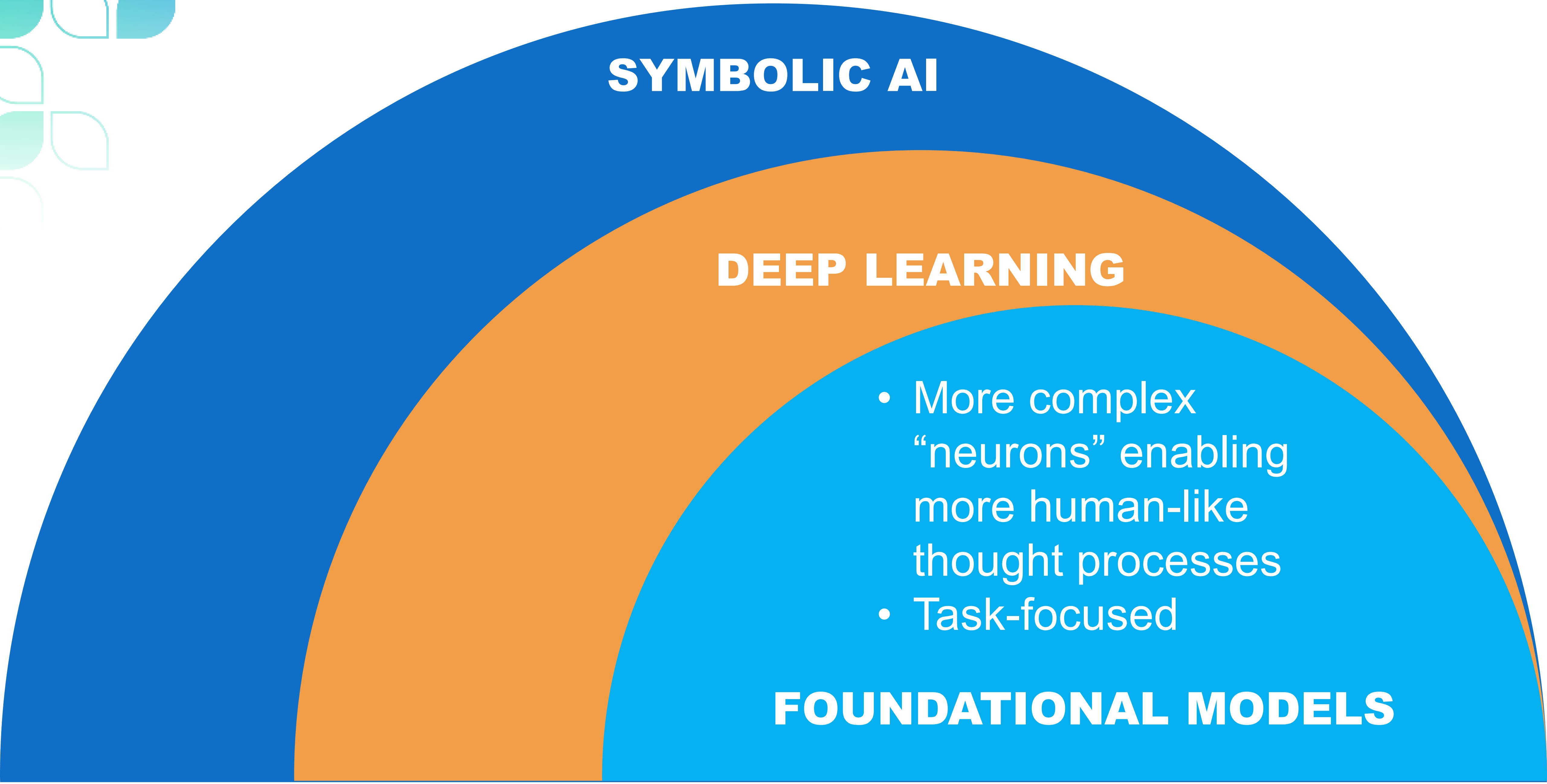
Howell MD et al. *JAMA*. 2024;331(3):242-244.

SYMBOLIC AI

- Focus during the 1980s through the 2010s
- Large datasets used to train models with more computation and labeling
- AI systems gain ability to perform more processes

DEEP LEARNING

Howell MD et al. *JAMA*. 2024;331(3):242-244.



Howell MD et al. *JAMA*. 2024;331(3):242-244.

How Did AI "Learn"?

Datasets were fed into algorithms to help train models to go from an input to an output

SUPERVISED LEARNING

- Labeled data is inputted alongside definitions of labels and desired outputs
- Model is supervised to ensure that desired outputs are achieved through the algorithm and processing
- Focused on pattern/relationship to form classification of data

UNSUPERVISED LEARNING

- Unlabeled data fed into a model
- Model develops algorithms and processing though interpretation of data
- Uses data patterns to cluster data for recognition

Jiang T et al. *Behav Ther*. 2020;51(5):675-687.

What is ChatGPT?

ChatGPT can make mistakes. Consider checking important information.

ChatGPT

ChatGPT is an advanced language model developed by OpenAI. It is part of the GPT (Generative Pre-trained Transformer) architecture. ChatGPT is designed to understand and generate human-like text based on the input it receives. It has been trained on diverse internet data, enabling it to comprehend and respond to a wide range of topics and questions. Users can interact with ChatGPT by providing prompts or questions, and the model generates responses based on its understanding of the context and patterns learned during training. While powerful, it's important to note that ChatGPT may not always be perfectly accurate or contextually precise.

Image captured from chatgpt.com on October 16, 2024.

Early Clinical Utilization of AI in Health Care

- Early AI tools were focused on image recognition
  - **Computer vision**
- Trained to emulate human neuro processes to recognize shapes
- Issues:
  - Lack of processing power for quick results
  - Models had limited data to utilize
  - Technology advancements limited utility
- "AI winter"
  - 1970s through the early 2000s

- Refocus on larger datasets to utilize AI in radiological imaging
  - Rise of electronic health record (EHR) systems and larger data banks of images
  - Ability to train models to spot irregularities
  - Increased use of technological development leading to faster processing of images
- **Oncology becomes an area of focus due to several issues:**
  - Costs and expected burden in coming decades
  - Large datasets lacking structure

Kaul V et al. *Gastrointest Endosc*. 2020;92(4):807-812; Farina E et al. *Future Sci OA*. 2022;8(4):FSO787; Kann BH et al. *Cancer Cell*. 2021;39(7):916-927.

AI Clinical Research Status

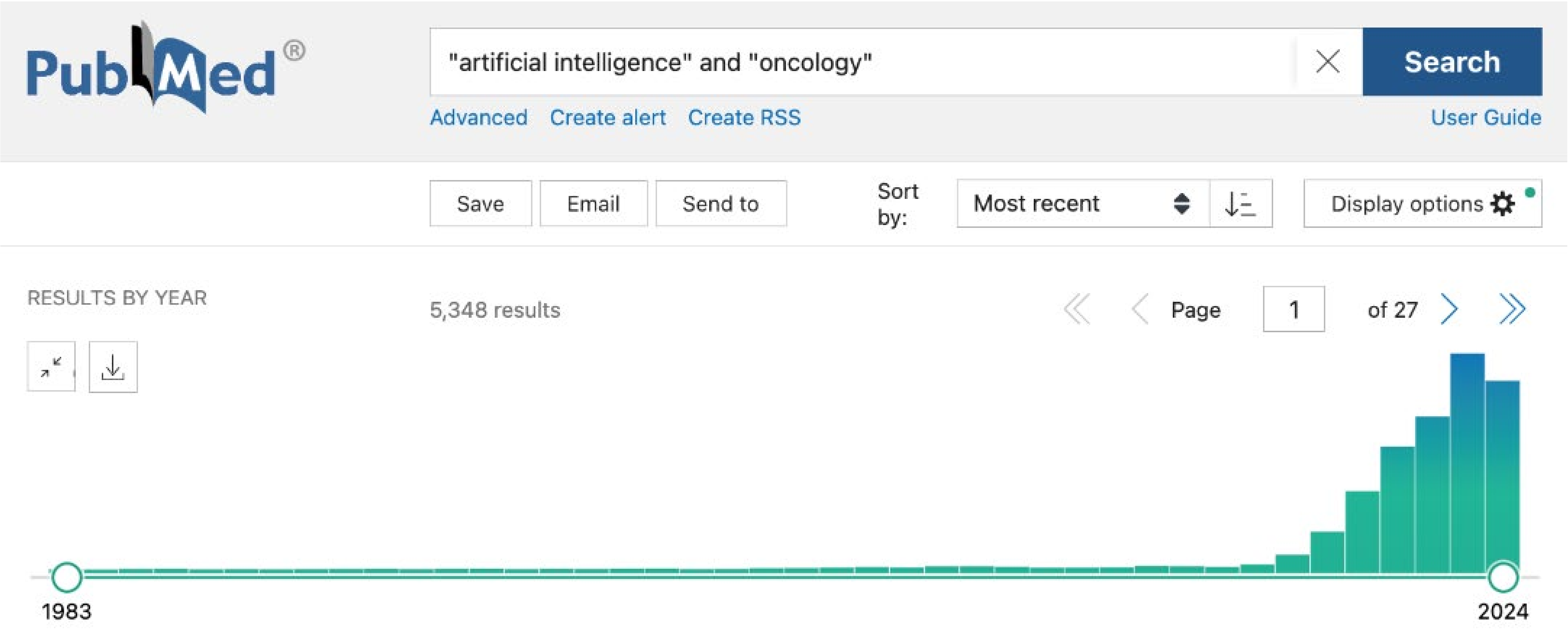


Image captured from https://pubmed.ncbi.nlm.nih.gov/ on October 16, 2024.

Ongoing AI Oncology Studies

Breast cancer

- Breast cancer screening with an AI platform for mammography (AI-STREAM) [NCT05024591]
- AI-driven breast cancer screening [NCT05650086]
- Neural network–guided combination regimen development [NCT05177432]

Lung cancer

- I3LUNG: a framework for data-driven lung cancer management [NCT05537922]
- Real-world data to drive lung cancer treatment (APOLLO11) [NCT05550961]
- Integrating AI and radiomics for nodule stratification [NCT05375591]

Leukemia/hematologic cancers

- Deep learning and digitalized blood smears for leukemia diagnosis (BELUGA) [NCT04466059]
- AI-guided quality of life management post immunotherapy [NCT05626764]

Large rise on the focus of the utilization of AI in oncology

- Use in the development of novel pharmaceutical products for treatment
- Biomarker development
- Screening and radiological imaging
- Personalized regimen development
- Patient education and counseling

Senthil Kumar K et al. *Am Soc Clin Oncol Educ Book*. 2023;43:e390084.

Areas of Opportunity for AI in Oncology

Cancer Prevention & Risk Stratification	Early Screening	AI-Assisted Diagnosis
Intelligent Radiation Oncology	AI And Teleoncology	Prediction Of Treatment Outcome

Lin B et al. *J Natl Cancer Cent*. 2022;3(1):83-91.

Available Datasets for AI Integration in Oncology

Image data	PET/CT scans, MRI scans, dermoscopic images, mammograms
Omics data	• Genomics • Transcriptomics • Proteomics • Epigenomics • T-cell receptor sequencing
Clinical data	• EHR • Patient response to therapy • Electronic patient-reported outcomes (ePROs)

Bhinder B et al. *Cancer Discov*. 2021;11(4):900-915.

Integration of Technology Datasets

Digital Pathology/Biomarker Development
Leverage AI for rapid pathology analysis of multi-institutional samples.

Digital Pathology/Biomaker Translation
Identify new digital biomarkers to direct treatment guidance.

Drug Discovery
Utilize AI for target-driven identification of potential therapies (new design or repurposing).

Drug Development
Match patients to clinical trials and appropriate combination therapies alongside targeted therapies.

Biomarker-Driven Personalized Cancer Therapy
Use patient data to design individualized treatment plan and digital biomarkers to gauge outcomes.

Issue will be if these AI models can be scaled to a larger population. They have only been demonstrated in small select cohorts thus far. Larger datasets across wider populations are still needed.

Senthil Kumar K et al. *Am Soc Clin Oncol Educ Book*. 2023;43:e390084.

AI Detection & Screening for Cancer

Historical challenges: early computer-aided design (CAD) for breast cancer had little impact on diagnostic accuracy despite 20+ years of investment

Recent advances in AI: modern AI and ML are now enhancing cancer screening and diagnostics

FDA-approved AI tools: 20+ AI tools for breast imaging approved by FDA; adoption varies, showing both promise and challenges

Expanded AI applications: AI being used in risk assessment, decision support, density quantification, workflow optimization, and chemotherapy response

AI vs traditional imaging: AI (eg, Super Vector Machine) improves specificity, sensitivity, and accuracy to complement radiologists

Taylor CR et al. *Diagnostics (Basel).* 2023;13(12):2041; Silva HECD et al. *PLoS One*. 2023;18(10):e0292063.

Deep Learning Algorithm for Pancreatic Cancer Trajectory

Utilized AI to analyze clinical data from **over 9 million patients, including 27,900 cases of pancreatic cancer**, sourced from the Danish National Patient Registry (DNPR) and the US Veterans Affairs (US-VA).

ML models were trained on the sequence of **disease codes from patient histories** to predict cancer occurrence within various time frames, with the Danish model achieving an area under a receiver operating characteristic (AUROC) curve of 0.88 for **predicting cancer within 36 months**.

When the Danish model was applied to US-VA data, performance decreased (AUROC = 0.71). This prompted retraining to improve accuracy, which resulted in an AUROC of 0.78.

The study's findings suggest that AI models can significantly enhance the design of surveillance programs for high-risk patients, potentially enabling earlier detection and improving outcomes for those at elevated risk of pancreatic cancer.

Placido D et al. *Nat Med*. 2023;29(5):1113-1122.

AI-Enabled Primary Care Scans

- **FDA authorization:** on January 17, 2024, the FDA authorized DermaSensor, **the first AI-enabled device for skin cancer detection in primary care.**
- **Clinical evidence:** the device's approval was supported by 3 studies, including a pivotal trial (DERM-SUCCESS) showing 95.5% sensitivity. This highlights AI's potential in enhancing primary care physician (PCP) diagnostic performance.
- **Specificity challenges:** while DermaSensor demonstrated high sensitivity, its low specificity remains a challenge. This echoes issues seen in other AI-enabled dermatologic devices.

Venkatesh KP et al. *NPJ Digit Med*. 2024;7(1):156.

- **Impact on primary care:** the device improves PCP diagnostic capabilities, reducing false negative referrals by half; however, it also leads to a decrease in specificity, **raising concerns about unnecessary referrals.**
- **Access and equity:** DermaSensor could address dermatology access limitations, especially in underserved areas; however, further research is needed on its use in rural settings and **diverse populations** (97% of patients studied were White).
- **Regulatory conditions:** FDA requires postmarket testing in underrepresented populations due to the lack of diversity in clinical trials. Testing is especially required for patients with darker skin tones.

AI for Predicting Outcomes in Cancer Care

- **Enhanced clinical decision-making:** increasingly influencing clinical decision-making by predicting critical outcomes such as mortality, cardiac arrest, and treatment responses in cancer care.
- **Individualized care:** AI and ML technologies are advancing personalized oncology by accurately predicting patient prognosis, treatment outcomes, and survival, often surpassing traditional methods.
- **AI in prognostication:** deep learning and radiomics are being applied to radiology images to predict cancer outcomes, response to therapies, and recurrence. This offers more precise and data-driven prognostic insights.
- **Impact of advanced AI techniques:** techniques like convolutional neural networks (CNNs) and AI-based survival prediction models are proving more effective than conventional approaches, enabling better risk stratification and treatment planning.
- **Challenges and future directions:** AI adoption in outcome prediction faces challenges, including data curation, interpretability, and integration into clinical workflows. This highlights the need for ongoing research and development.

Shamout F et al. *IEEE Rev Biomed Eng*. 2021;14:116-126; Zhang B et al. *J Multidiscip Healthc*. 2023;16:1779-1791; Bera K et al. *Nat Rev Clin Oncol*. 2022;19(2):132-146.

AI Cancer Survivability Calculator

- **Novel AI-based tool:** researchers have developed a Cancer Survival Calculator using AI to provide personalized estimates of long-term survival for newly diagnosed cancer patients. This surpasses traditional methods focused solely on cancer staging.
- **Key influencing factors:** for breast cancer, survival predictors include surgery, age at diagnosis, tumor size, and time to treatment. In thyroid cancer, age, tumor size, time to treatment, and lymph node involvement are crucial. For pancreatic cancer, surgery, histology, tumor size, and age are most impactful.
- **Advanced features:** the Cancer Survival Calculator incorporates specific tumor biomarkers and treatment variables that older calculators often overlook, leading to more accurate survival predictions across various cancer types.
- **Next steps:** the researchers plan to finalize the tool's user interface for clinical use, followed by pilot testing at selected cancer centers, with the goal of expanding the calculator to include all cancer types in the National Cancer Database.

The ASCO Post. October 24, 2023. Accessed October 16, 2024. https://ascopost.com/news/october-2023/ai-based-calculator-may-accurately-predict-long-term-cancer-survival/

AI and Medication Dosing

- **AI-driven precision in medication dosing**: enhances medication dosing by personalizing treatment plans based on real-time data analysis, optimizing drug combinations, and adapting to patient-specific responses, ultimately improving efficacy, reducing adverse effects, and extending progression-free survival (PFS) in cancer therapy.
- **Personalized drug combination design with QPOP**: the quadratic phenotypic optimization platform (QPOP) combines lab experimentation with optimization analysis to create patient-specific drug combinations, reducing data points needed for testing and improving treatment efficacy for chemotherapy-resistant cancers.
- **scFPM for single-cell drug profiling**: the single-cell functional precision medicine (scFPM) platform uses high-content microscopy for drug efficacy profiling at the single-cell level, with a prospective trial showing improved PFS in 54% of 143 patients with advanced cancer within 5 days of sampling.
- **AI and evolutionary game theory in cancer therapy**: evolutionary game theory models cancer cell resistance and physician strategies, proposing dynamic treatment protocols that adapt to tumor evolution. This significantly increases time to progression and reduces standard dosing by 47%.

Senthil Kumar K et al. *Am Soc Clin Oncol Educ Book*. 2023;43:e390084; Goh J et al. *Sci Transl Med*. 2022;14(667):eabn7824; Kornauth C et al. *Cancer Discov*. 2022;12:372-387.

Case Examples of Utilization

Using AI Model for Clinical Decision Support System (CDSS) Colorectal Cancers Dosing

- **DoMore-v1-CRC development:** the DoMore-v1-CRC marker, developed using deep learning on hematoxylin- and eosin-stained tissue sections, outperformed existing molecular and morphological markers for predicting patient outcomes after colorectal cancer surgery.
- **Risk stratification system:** researchers combined DoMore-v1-CRC with pathological staging markers to create a CDSS that categorizes patients with stage II or III colorectal cancer into 3 risk groups based on cancer-specific survival.
- **Validation and findings:** in a validation cohort of 1075 patients from the QUASAR 2 trial, the new system demonstrated significantly better prognostic accuracy than current guideline-based risk stratification, with distinct survival rates for low-, intermediate-, and high-risk groups.
- **Clinical implications:** the system's ability to more accurately identify low-risk patients suggests that avoiding adjuvant chemotherapy in these cases may be safe, and may potentially reduce treatment-related morbidity, mortality, and costs.

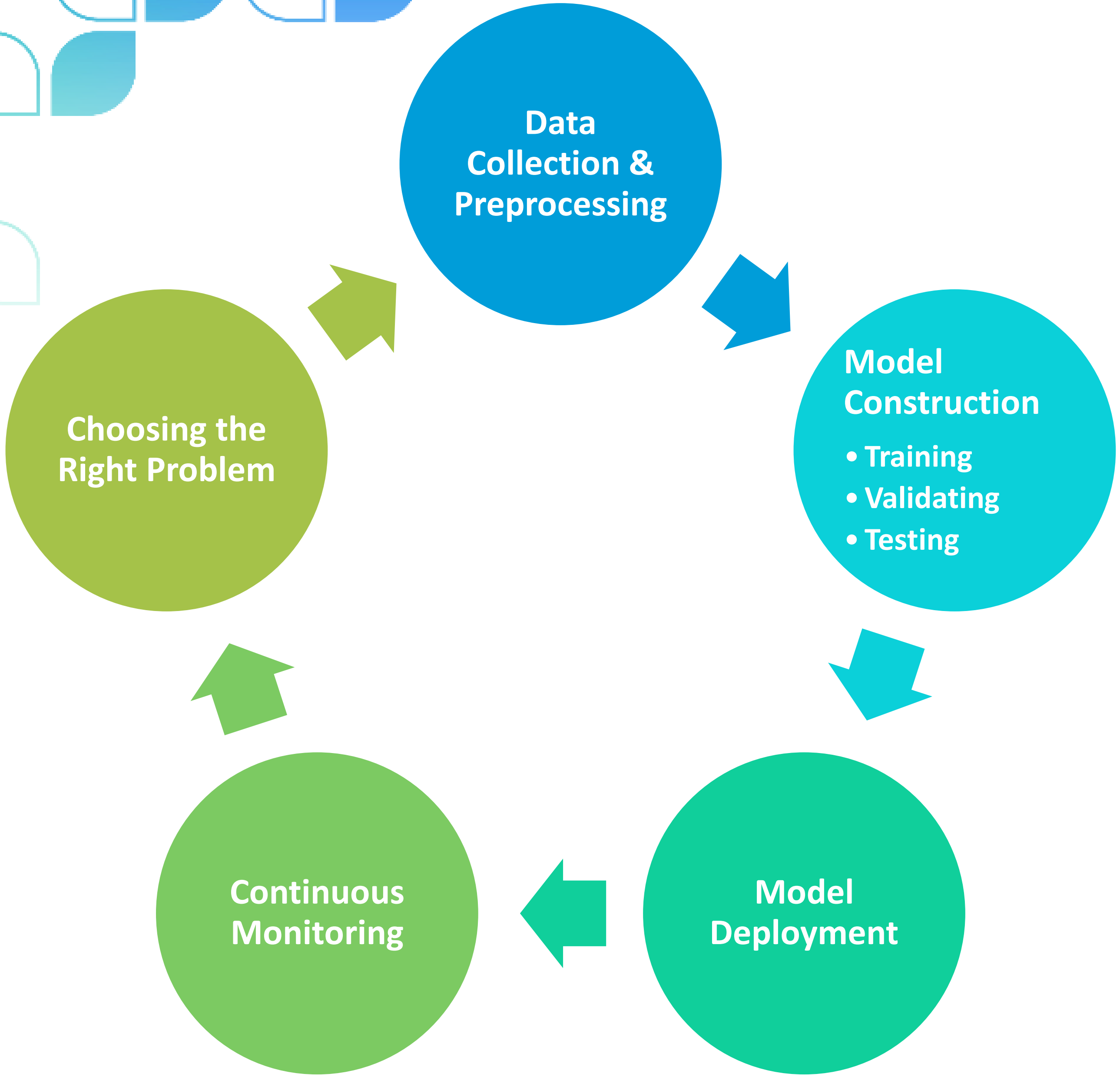
Kleppe A et al. *Lancet Oncol*. 2022;23(9):1221-1232.

Case Examples of Utilization

Predicting Febrile Neutropenia

- **Incidence and risk factors:** febrile neutropenia (FN) occurred in 43.8% of 933 patients with breast cancer who underwent chemotherapy. Higher incidence was associated with factors such as age, cancer staging, use of taxane-based regimens, and blood counts 5 days post chemotherapy.
- **Prediction model development:** the study aimed to identify risk factors for FN and used demographic, clinical, pathological, and therapeutic data to build prediction models using ML algorithms.
- **Model performance:** the prediction model based on conventional logistic regression achieved an area under the curve (AUC) of 0.870, while ML algorithms improved the AUC to 0.908, demonstrating superior predictive accuracy.
- **Clinical implications:** the improved prediction of FN with ML models suggests that high-risk patients could benefit from primary prophylaxis with granulocyte colony-stimulating factor (G-CSF) to prevent FN during chemotherapy.

Cho BJ et al. *Sci Rep*. 2020;10(1):14803.



Farina E et al. *Future Sci OA*. 2022;8(4):FSO787.

AI Process

- Ensure quality data are collected and processed (big risk for bias)
- Create a model (most time-intensive component)
- Deploy and test the model
- Have oversight to make sure the model works and does not drift
- Ensure model is being used for appropriate population

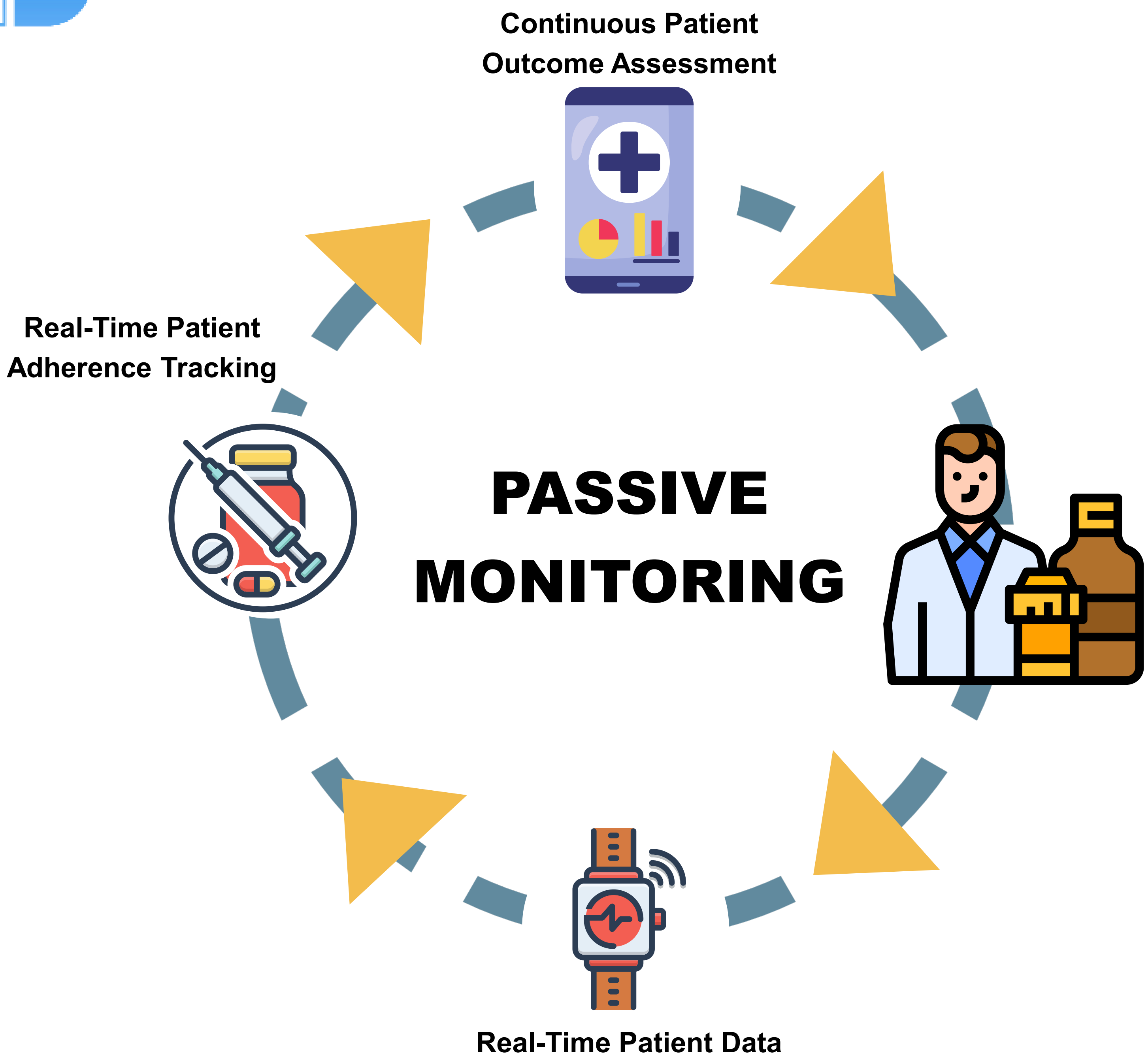


Image developed by Timothy Aungst, PharmD.

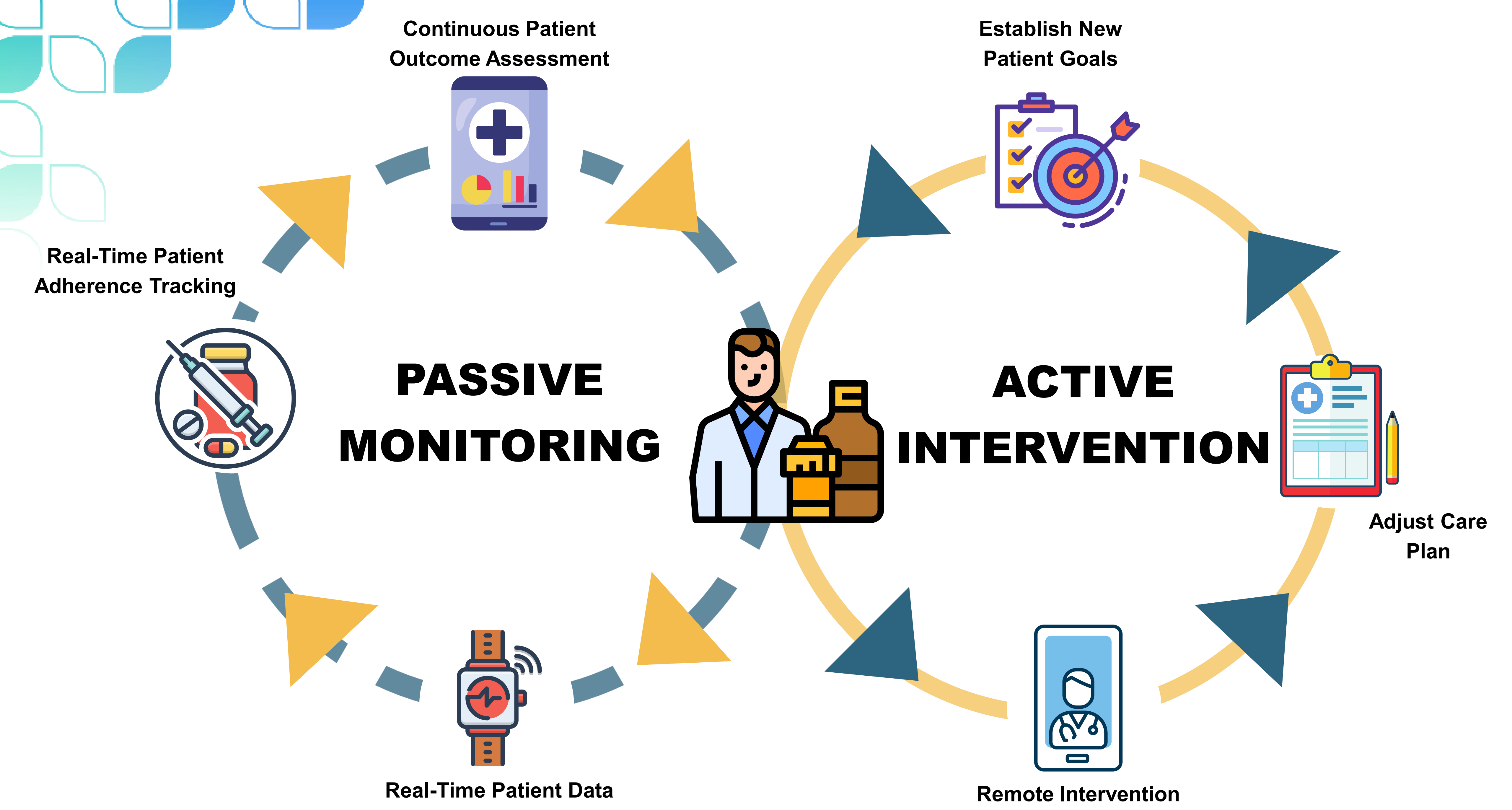


Image developed by Timothy Aungst, PharmD.

Sample AI Workflow: CURATE.AI

Guided Dosing

Prospective Calibration

- Calibration of doses
- Building patient dataset co-created with clinicians

Digital Avatar

Construction of CURATE.AI Profile

- Identification of right doses to optimize treatment
- Image/ biomarkers to predict response

Clinical Team

Dosage Recommendation

- Dose modulation by clinicians to set safety ranges
- Doses checked and approved by clinician

Patient

Personalized Cancer Treatment

- Effects of treatment integrated back into digital avatar

Senthil Kumar K et al. *Am Soc Clin Oncol Educ Book*. 2023;43:e390084.

AI and Pharmacy

- Growing interest within the profession to leverage AI for both operations and clinical services
  - Automation for medication distribution services across all pharmacy sectors
- Utilization of AI with pharmacy-related data and EHR information:
  - CDSS expansion for real-time recommendations and support
  - Increased insight on patient outcomes
  - Dosing of medications and monitoring for patient safety
  - Identification of patients for pharmacy-related services
- Exploration of pharmacy-related agents/bots
  - Medication reconciliation
  - Postdischarge education

Chalasani SH et al. *Explor Res Clin Soc Pharm*. 2023;12:100346.

Medication Adherence Tracking

Prescription Refill Management

Chronic Disease Management

Inventory Management

Drug Interactions

Payments & Billing

Medication Reconciliation

Prescription Transfer

Adverse Drug Reaction (ADR) Monitoring

Personalized Medication Management

Drug Shortages Management

Patient Education & Screening

Patient Scheduling & Triage

Drug Formulary Management

Drug Acquisition

Prior Authorizations

Khan O et al. *Intelligent Pharmacy*. 2023;1(1):32-40.

AI and Pharmacy: Oncology Considerations

- AI may be utilized by pharmacists to help optimize therapy through:
  - Dosing considerations
  - Regimens based on "omic" data from patients
  - Insights into outcomes (predicted)
  - Monitoring for ADRs and negative events
- Aid in identification of patients that may be enrolled into clinical trials
- Preparation of personalized education for the patient, taking into consideration education, language, etc
- Aid in outreach for patients regarding adherence to therapy, collecting patient data remotely, and conducting remote assessment

Chalasani SH et al. *Explor Res Clin Soc Pharm*. 2023;12:100346.

Current Issues Regarding AI in Oncology

- Accuracy & Explainability
- Regulatory Landscape
- Ethical Concerns
- Education & Training

Accuracy and Explainability

Accuracy Concerns

- There have been many concerns related to the use of AI tools due to several limitations:
  - **Bias:** model outputs reflect limited data that may not represent a wider population
  - **Hallucinations:** models produce outputs that are incorrect
  - **Drift:** models become divergent on their responses

What Is Explainability?

- Understood as a characteristic of an AI-driven system that allows a person to reconstruct why a certain AI came up with the presented predictions
  - Essentially, do you understand the mechanism of action (MOA) of the AI model?
- Issues:
  - **Legal:** how much has to be exposed on MOA?
  - **Regulatory:** no guidance
  - **Medical:** training and knowledge

Amann J et al. *BMC Med Inform Decis Mak*. 2020;20(1):310; Sahiner B et al. *Br J Radiol*. 2023;96(1150):20220878.

AI Regulatory Landscape

- Current regulatory pathways for AI in health care are being developed in:
  - The United States of America, the United Kingdom, Europe, Australia, China, Brazil, and Singapore
- Mixture of “hard” and “soft” laws:
  - Hard: legislation and laws set by governing bodies
  - Soft: professional guidelines, voluntary standards, codes of conduct, recommendations, agreements, national action plans, or policy documents, which are not legally binding and are adopted by governments and the industry
- *There are no specific regulatory pathways for AI-based technologies in the US, but the FDA evaluates them under the existing regulatory framework for medical devices.*
- Possible European Union/US guiding documents in coming years focused on AI trust.

Palaniappan K et al. *Healthcare (Basel).* 2024;12(5):562.

AI and the FDA

The FDA has authorized 950 AI/ML-enabled medical devices.

- The FDA reviews medical devices through an appropriate premarket pathway
  - Premarket clearance through 510(K), De Novo classification, or premarket approval
  - This pathway was not designed to account for AI/ML technologies
- Over the past 5 years, the FDA has worked to change how it evaluates digital health and AI/ML-enabled technologies, with involvement across multiple organizations:
  - FDA's Center for Biologics Evaluation and Research (**CBER**), Center for Drug Evaluation and Research (**CDER**), Center for Devices and Radiological Health (**CDRH**), and the Office of Combination Products (**OCP**)

FDA. Updated August 7, 2024. Accessed October 16, 2024. https://www.fda.gov/medical-devices/software-medical-device-samd/artificial-intelligence-and-machine-learning-aiml-enabled-medical-devices; FDA. Accessed October 16, 2024. https://www.fda.gov/media/177030/download?attachment

Current FDA AI Focus

Total product life cycle (TPLC) approach for the oversight of AI-Medical Devices:

- Specific regulatory framework with the issuance of draft guidance on Predetermined Change Control Plan
- Good ML practices
- Patient-centric approach, including the transparency of devices to users
- Methods for the elimination of ML algorithm bias and algorithm improvement
- Real-world performance monitoring pilots

Good ML practice (GMLP) principles for AI development:

- High relevance of available data to the clinical problem and current clinical practice
- Consistency in data collection that does not deviate from the software as a medical device's intended use
- Planned modification pathway
- Appropriate boundaries in the datasets used for training, tuning, and testing the AI algorithms
- Transparency of the AI algorithms and their output for users

Palaniappan K et al. *Healthcare (Basel).* 2024;12(5):562.

Ethical Considerations with AI

How much do you trust AI?

- Would you trust it to manage your bank account?
- Would you trust it to perform household chores?
- Would you trust it to help write for you?
- Would you trust it to help give daily advice or answer questions?
- Would you trust it to give music suggestions?
- Would you trust it to help identify new items to shop for?
- Would you trust it to help you drive your car?

Would you trust AI to help treat your patient’s cancer?

AI Health Care Ethical Concerns

Concerns Related to AI and Health Care:

- Data bias and model development
- Informed consent and transparency
- Patient privacy and data protection
- Allocation and fairness of use
- Liability and accountability
- Explainability

Currently, there is limited training on AI health ethics for health professionals.

Cross-sectional study was conducted in countries from the Middle East and North Africa region on 501 **pharmacy professionals**:

- Participants expressed concerns about patient data privacy (58.9%), cybersecurity threats (58.9%), potential job displacement (62.9%), and lack of legal regulation (67.0%)
- Tech savviness and basic AI understanding were correlated with higher concern scores (*P* <0.001)

Weidener L et al. *JMIR Med Educ*. 2024;10:e55368; Weidener L et al. *Perspect Med Educ*. 2023;12(1):399-410; Hasan HE et al. *BMC Med Ethics*. 2024;25(1):55.

Oncologist Ethical Concerns Regarding AI

Cross-sectional survey conducted with 204 (52.7%) responses from oncologists across 37 states

- **Objective**: determine if participants agreed or disagreed that patients need to provide informed consent for AI model use during cancer treatment decisions
- 46.6% of participants had received some AI training
- 45.3% had familiarity with clinical decision models

- 84.8% of oncologists reported that AI needs to be explainable by oncologists but not necessarily by patients
- 81.4% agreed that patients should consent to the use of AI for cancer treatment decisions.
- 76.5% of oncologists felt responsible for protecting patients from biased AI algorithms
  - However, only 27.9% felt they were confident in their ability to do so

Hantel A et al. *JAMA Netw Open*. 2024;7(3):e244077.

AI Training and Education

- No set guidance on what AI training is needed for medical professionals
  - Current students and practitioners will have different needs alongside professional roles
- Topics discussed that may be of value:
  - Ethical use of AI in health care
  - Knowledge regarding AI terminologies and understanding basic principles
  - Training on the utilization of AI within clinical roles and responsibilities
- Growing interest in subset specialties using AI (eg, informaticists, AI specialists) for oversight and integration
- Pharmacy education with new Curricular Outcomes and Entrustable Professional Activities (COEPA) and Accreditation Council for Pharmacy Education (ACPE) standards have adopted digital health into the curriculum, which will see a growing focus on the clinical utility of technologies like AI into professional training

Sun L et al. *Am J Transl Res*. 2023;15(7):4820-4828; Weidener L et al. *JMIR Med Educ*. 2023;9:e46428; Abdel Aziz MH et al. *Am J Pharm Educ*. 2024;88(1):100615.

Conclusion

The application of AI in oncology is rapidly expanding, driven by the ability to analyze vast amounts of data to guide and optimize patient treatments and support the development of new therapies.

While AI models currently emphasize diagnostics, particularly through image recognition, there is growing interest in leveraging AI for precision care due to advancements in multiomics data and biomarker analysis.

Oncology pharmacists may increasingly use AI to optimize treatments. They aim to reduce adverse outcomes and improve clinical results by incorporating individual patient factors.

The use of AI in health care remains in a gray area, with future legislation and regulations likely to shape how these tools are employed in oncology.

Additional Resources

Resource (Link)	Description
Try-AI.org	Group focused on creating easily accessible information for those with little knowledge about AI.
AICollective.co	Created by 2 pharmacists seeking to help educate other pharmacists about AI.
DeepLearning.AI	For moderate to advanced practitioners looking to delve deeper into AI. Some courses will require a programming and computer science background.
Resources and Tools: AI in Cancer Research	National Cancer Institute resource page on AI and oncology.

Posttest Questions

Posttest Question 1

Which of the following is a current clinical application of artificial intelligence (AI) in oncology care?

A. Predicting patient adherence to oral chemotherapy
B. Enhancing image analysis for early cancer detection
C. Automating chemotherapy dosing adjustments
D. Recommending lifestyle changes for cancer prevention

Posttest Question 2

Which of the following best describes the role of AI in improving the accuracy of cancer prognosis?

A. Provides predictions solely based on genetic information
B. Integrates various data sources to offer personalized prognostic insights
C. Replaces the need for traditional prognostic tools
D. Focuses predictions on short-term survival rates and quality of life

Posttest Question 3

You are on a committee to oversee the rollout of a new patient care tool that will integrate with your electronic health record to help guide medication dosing for patients receiving cancer treatment. Which of the following points would be appropriate to consider regarding the ethical use of this product?

A. Cost to license product
B. Training required to utilize the software
C. Patient data used to train the model
D. Liability of using the product

Posttest Question 4

After participating in this activity, how knowledgeable are you in the use of artificial intelligence in cancer care?

A. Not at all
B. Somewhat
C. Moderately
D. Very
E. Extremely

Question and Answer Session

Thank you!