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Artificial Intelligence and the Future of Health Care

A Realist's View of Opportunities and Challenges

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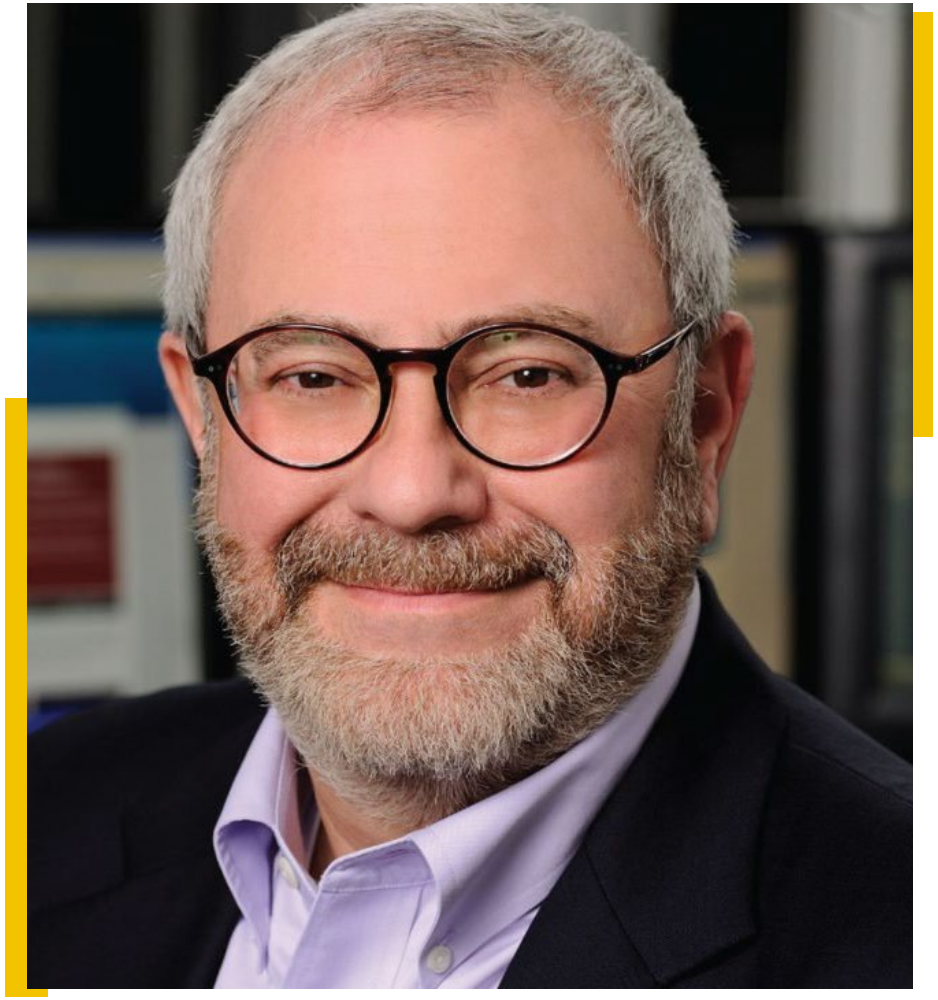
3/12/2026



Jonathan P. Weiner, DrPH

The Johns Hopkins Bloomberg School of Public Health

Professor of Health Policy & Management, Professor of Biomedical Informatics & Data Sciences, Founder and Co-Director of the JHU Center for Population Health IT, and Co-Inventor and Scientific Director of the JHU ACG Population Health Analytics System.

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Goals for Today

To explore how artificial intelligence (AI) and other types of advanced data science (DS) are reshaping ***the future of health care delivery.***

With a realist's eye, I will discuss a series of strategic issues with a special emphasis on the application of AI and DS to the fields of ***population health and health care system*** *management.*

Organization of Presentation:

- Key **frameworks and concepts** relevant to AI and DS.
- Key **opportunities and challenges** surrounding AI – with a special emphasis on "big data" and predictive analytics.
- A discussion of how the **Johns Hopkins ACG** population health analytics system represents an optimal **anchor for AI applications.**
- **Pragmatic advice** for how to move forward re: AI and DS activities.

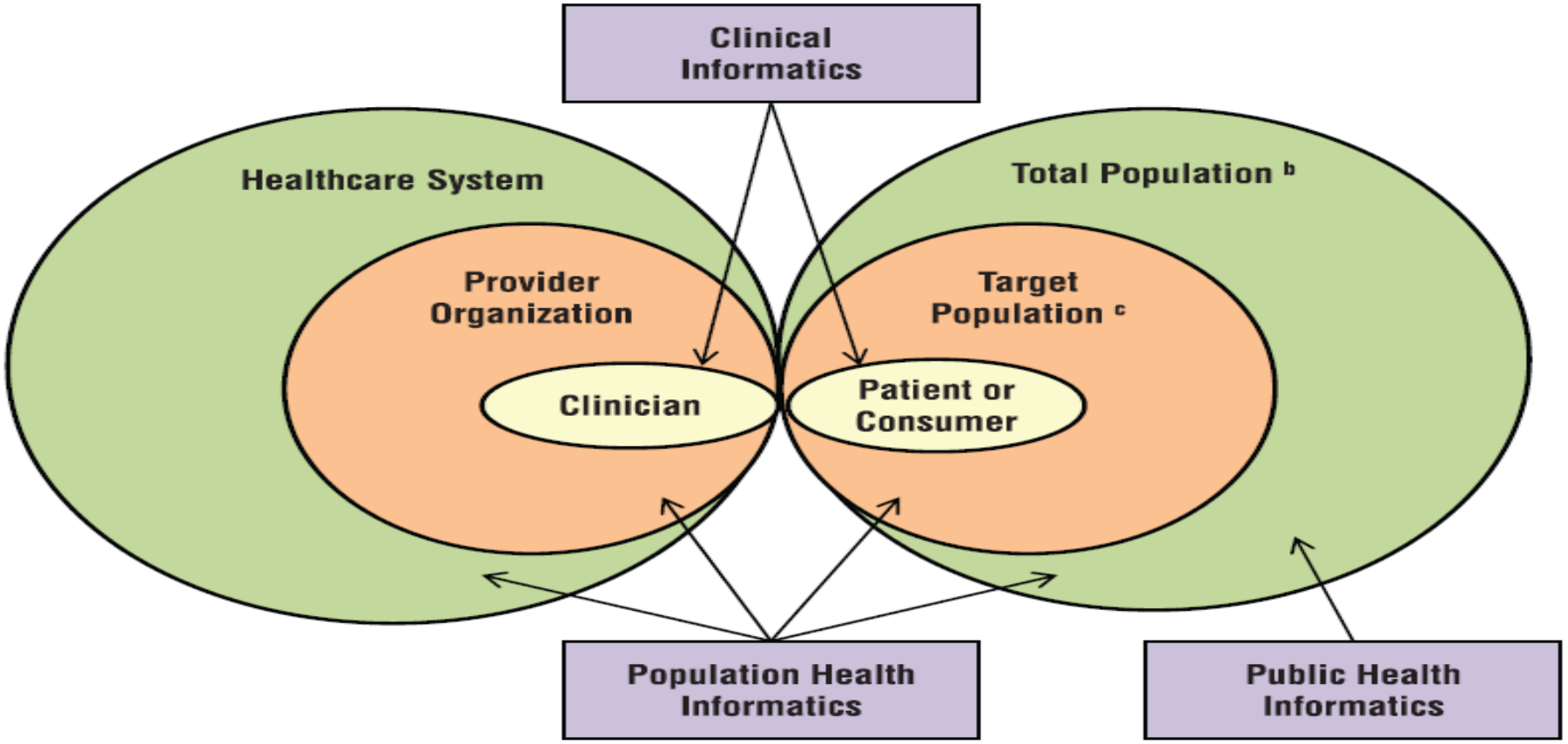
Center For Population Health IT *(CPHIT – "see fit")*

Mission: To Improve the health and well-being of populations and communities by advancing the state-of-the-art of health information technology, health informatics, and data sciences within public and private health care organizations and systems. **https://publichealth.jhu.edu/cphit**

The ACG System: CPHIT is the home of the JHU ACG System, which is a population health analytics predictive modeling platform in use in 26 nations for over 250 Million patients. ACGs are one of the biggest tech transfer/IP successes at JHU. **https://www.hopkinsacg.org**

What is Population Health Informatics?

Pop Health Informatics vs. Public Health Informatics vs. Clinical Informatics



Health informatics is the science of using data, information and knowledge to improve human health and the delivery of health care services. (Source: AMIA)

Source of Graphic: CPHIT White Paper in *JAMIA* - Kharrazi H. et. al. - https://www.ncbi.nlm.nih.gov/pubmed/27018264

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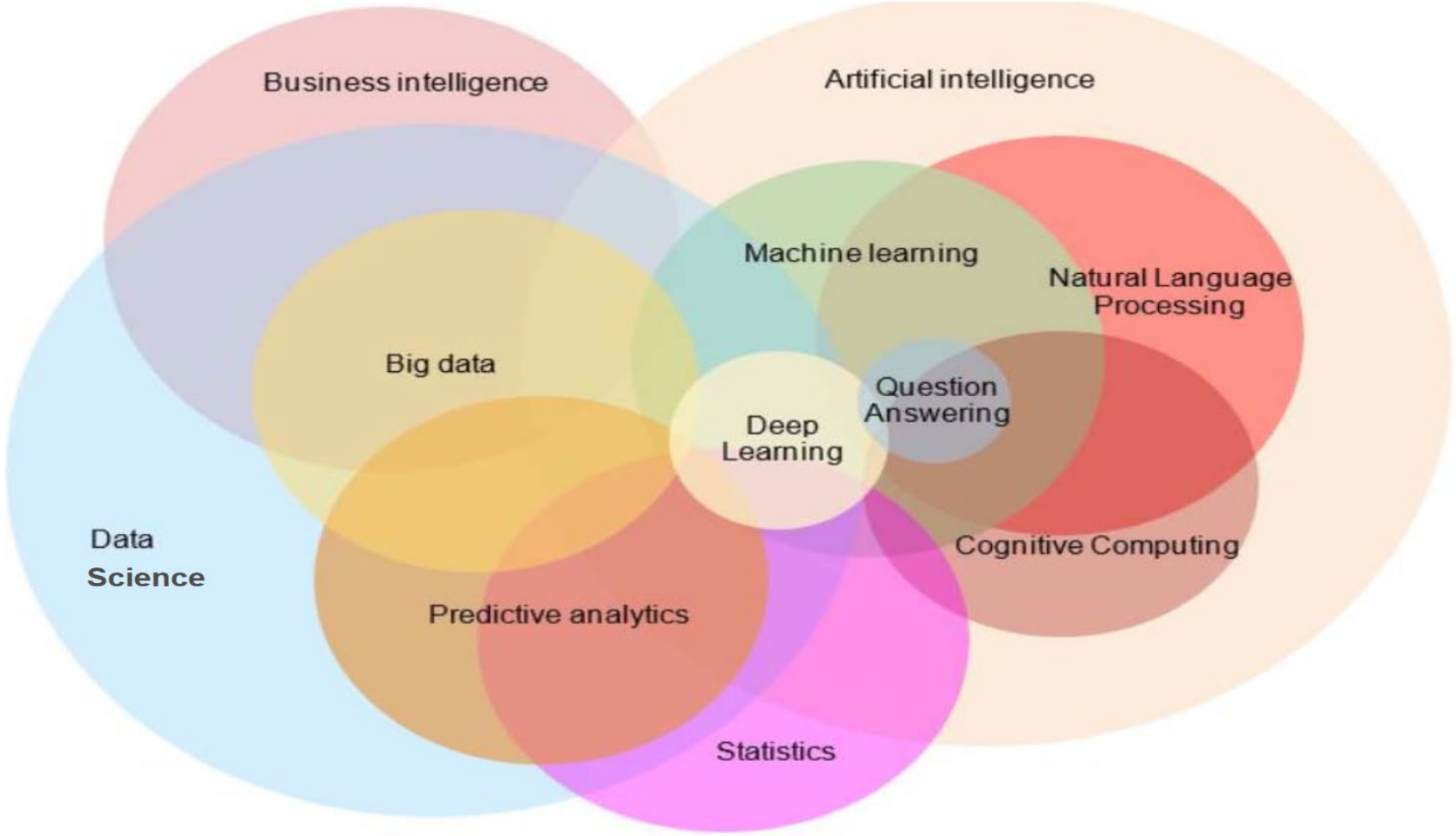
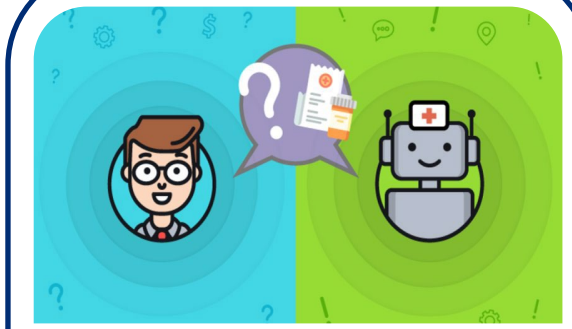
BIG-DATA
MACHINE-LEARNING
ARTIFICIAL-INTELLIGENCE
DATA-SCIENCES
PREDICTIVE-MODELING
EXPERT-SYSTEMS
ROBOTIC-PROCESS-AUTOMATION
DATA-MINING
BIG-DATA
LLM
ROBOTIC-SURGERY
GENERATIVE-AI
NLP
DEEP-NEURAL-NETS
AMBIENT-AI
DIGITAL-TWINS
GENOMICS
COGNITIVE-COMPUTING
BIO-INFORMATICS
AGENTIC-AI
DIGITAL-HEALTH-E-HEALTH-M-HEALTH
OMICS
COMPUTER-VISION
REMOTE-PATIENT-MONITORING
PRECISION-MEDICINE

The Overlapping Data Science Fields

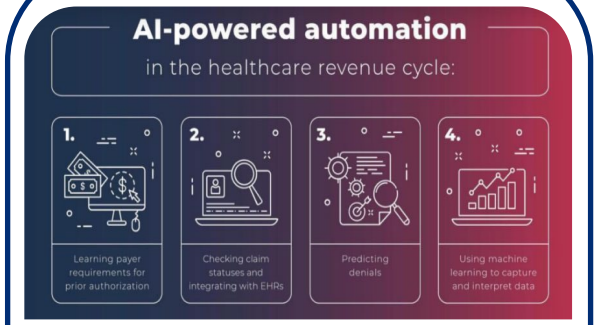
There is not always consensus regarding terms



The Scope of "AI" in Health Care is Still in Flux



"Chat-bot" / "agentic AI" / "generative AI" applications apply "large language models" (LLM) "agents" to extract or "generate" useful information from existing data/knowledge repositories.



Automation and digitalization of administrative and clinical workflow. Sometimes termed "robotic process automation" (RPA).

Advanced robotics & sensing to support a machine's interaction with the physical world. (This includes reading images.)

Extracting and creating knowledge from (raw) **"Big Data,"** often through **predictive modeling.**

An "Official" Working Definition of Artificial Intelligence and Machine Learning

- **Artificial Intelligence (AI)** enables computer systems to perform tasks normally requiring human intelligence.
- **Machine Learning (ML)** is a type of artificial intelligence that gives computers the ability to learn without being programmed by humans.

Source: US Department of Health and Human Services (DHHS) - Office of the Chief AI Officer https://www.hhs.gov/about/agencies/asa/ocio/ai/index.html

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The Big Data AI Domain is A Focus Area of This Talk

A suggested framework for thinking about how AI and other data sciences can be applied to Health Care Analytics along the continuum of:

Big Data Curation	Knowledge Creation	Knowledge Application

Information Curation / Management

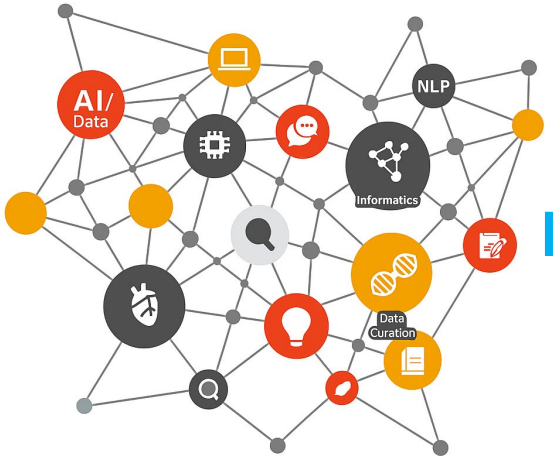
The Big Data / Feature Layers

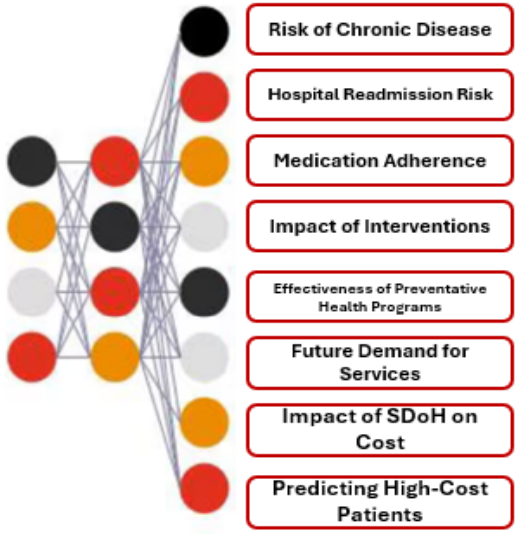
Knowledge Creation

Analytics / Data Mining

Knowledge Application

AI Supported Health and Healthcare Improvement



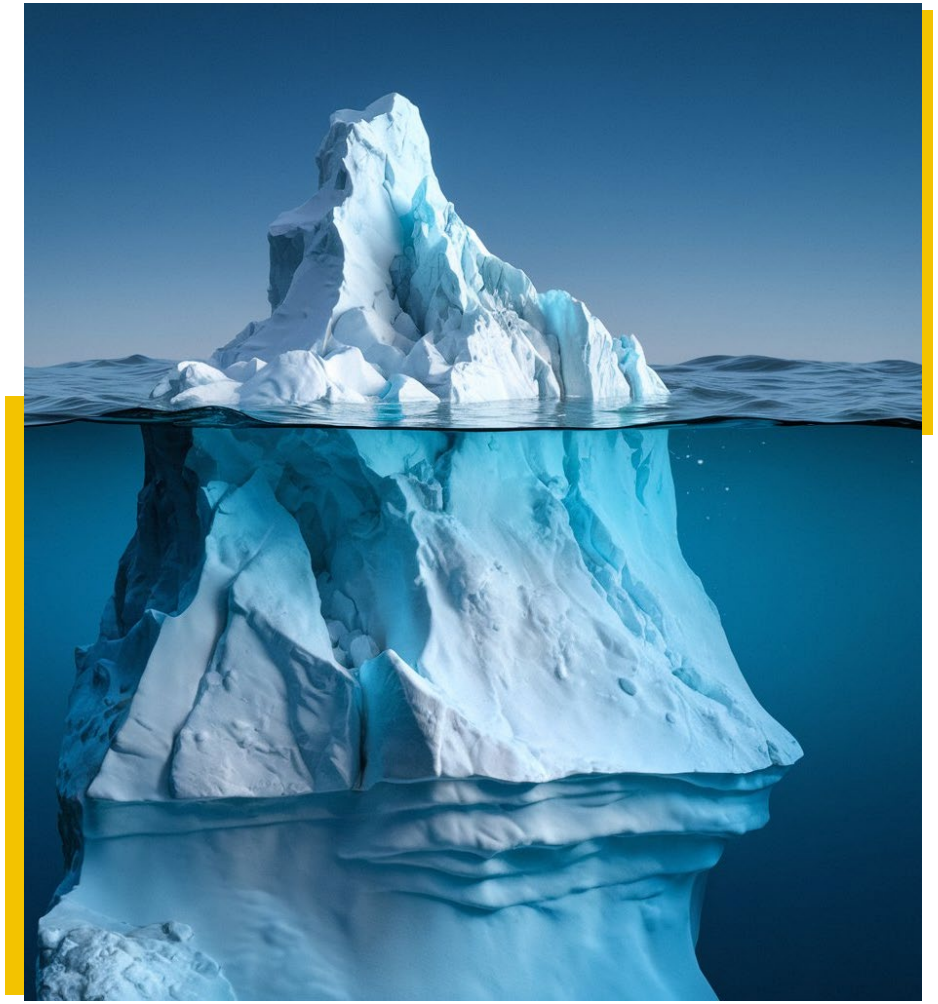


- Informatics
- Measurement Sciences
- NLP / Ambient AI

- Predictive Modeling
- Machine Learning
- Data / Decision Sciences

- Agentic / Generative AI
- Digital Decision Support Tools
- Robotic Process Automation

Source: J. Weiner – CPHIT 2025 - center graphics adapted from PWC



We Need To Cultivate a Realistic View of the Role of ML & AI

When taken as a whole, the public health and clinical disciplines, subject matter expertise, ethics and non-AI data science (e.g., informatics, biostatistics) usually have a greater impact on accuracy and value of AI analytic use cases, than does the "AI/ML" computer science tool-kit alone.

Population Health Analytics in an Era of Machine Learning

Using The Johns Hopkins ACG as a framework for the Application of Artificial Intelligence (AI)

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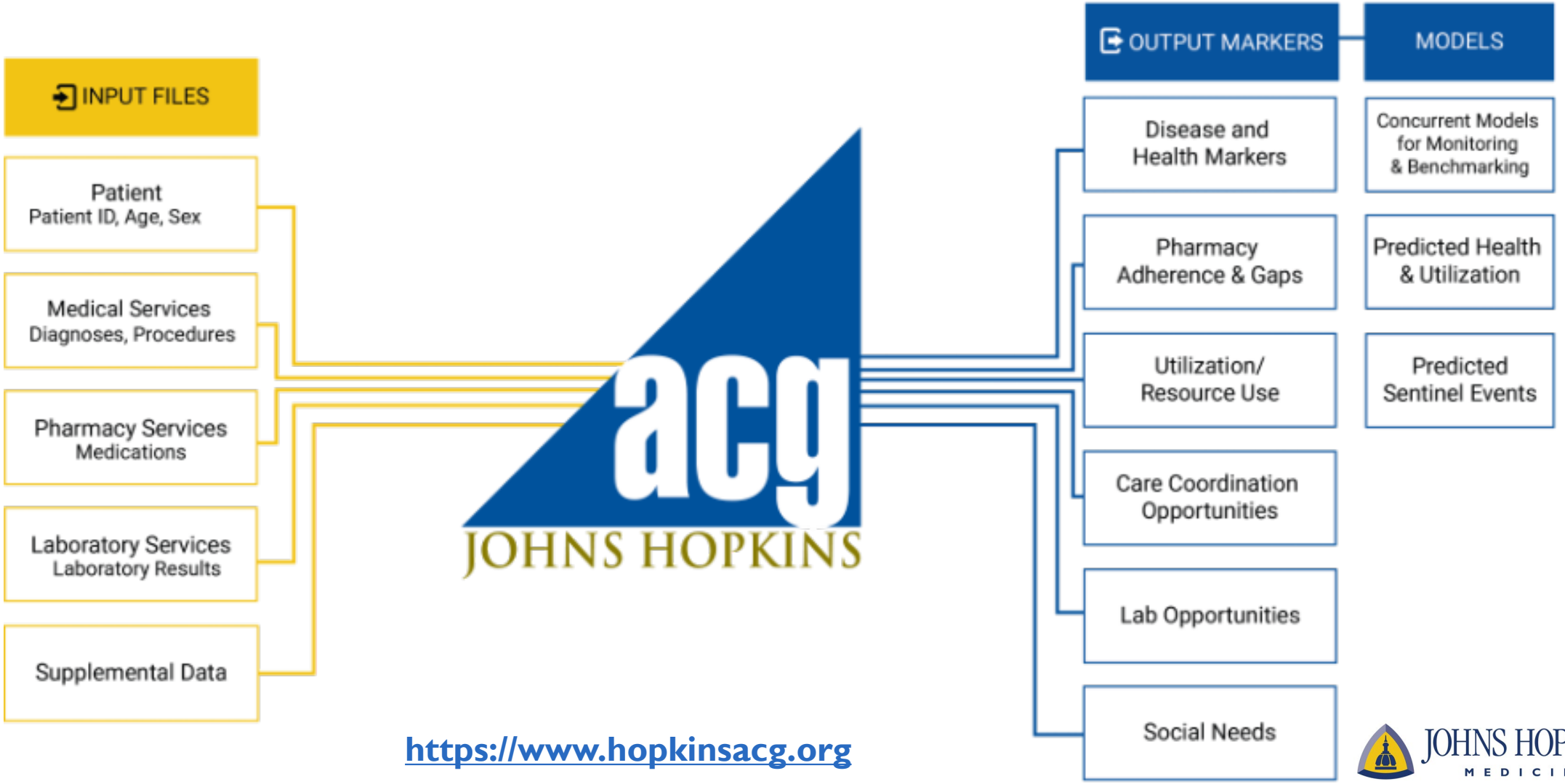
The Globally Accepted JHU ACG System

A central framework for Population Health AI Applications



https://www.hopkinsacg.org

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The Johns Hopkins ACG System – *A Quick Review*

Addressing the analytic challenge of 100,000 ICD diagnosis codes and 100,000 NDC (Rx) codes factorial

One of the most widely used **Population Based Risk Adjustment/ Stratification/ Predictive modeling** methodologies in the world. **In use in 24+ nations for 250 M+ patients.** One of the most successful tech transfer/IP ventures at JHU.

Based on 35+ years of R&D at the JHU Bloomberg School of Public Health. **Dozens of faculty experts** in public health, medicine, pharmacy, health services research and data sciences have contributed to this state-of-the-art method. **Over 12,000+ academic articles.**

Measures risk and need across large populations. Recognizes that patients present with **"morbidity profiles" and not just diseases.** Uses ICD and NDC codes in claims and EHRs. ACG software calculates **300+ predictive risk scores and measures.**

The Johns Hopkins ACG System is supported by a large global network of commercial partners. **R&D based at JHU Center for Population Health IT** (CPHIT) and **distributed by JH HealthCare Solutions. SS&C is our lead partner in the USA.**

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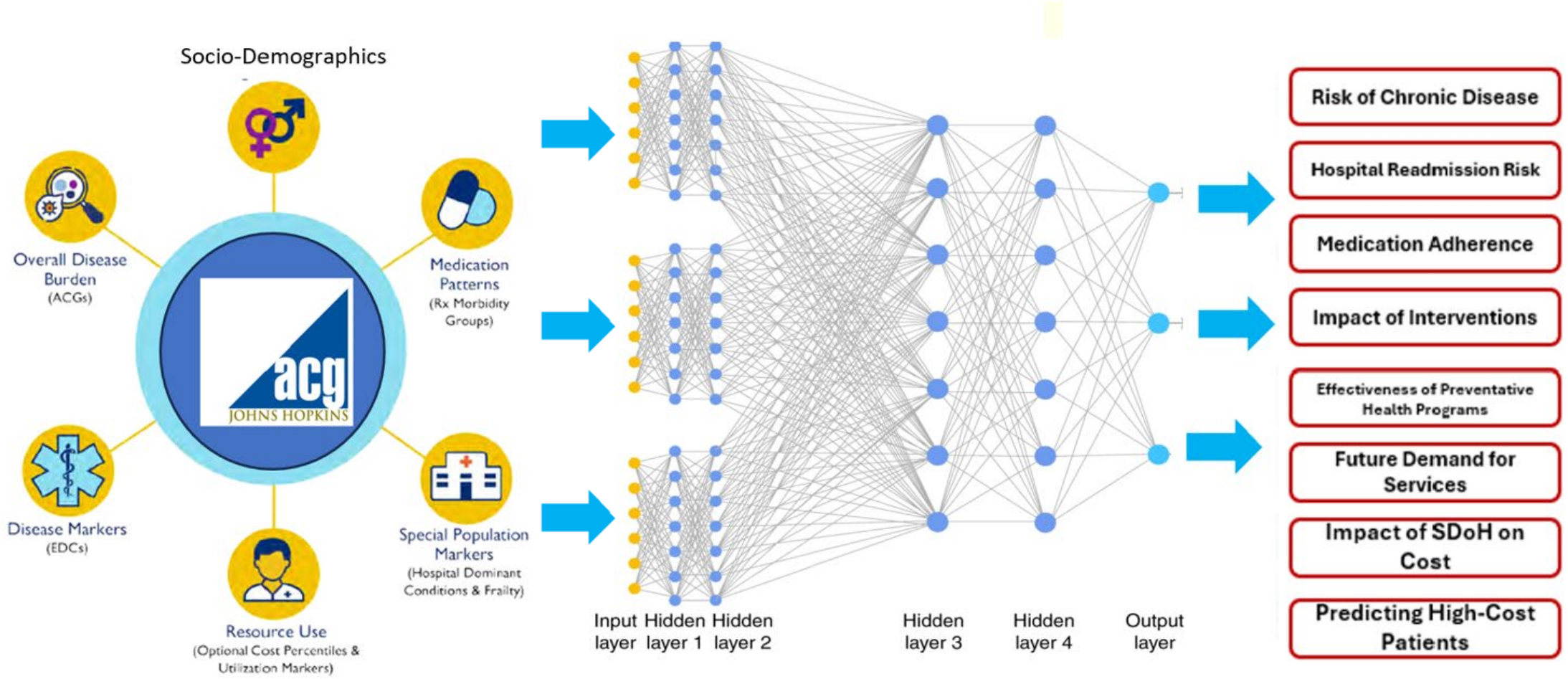
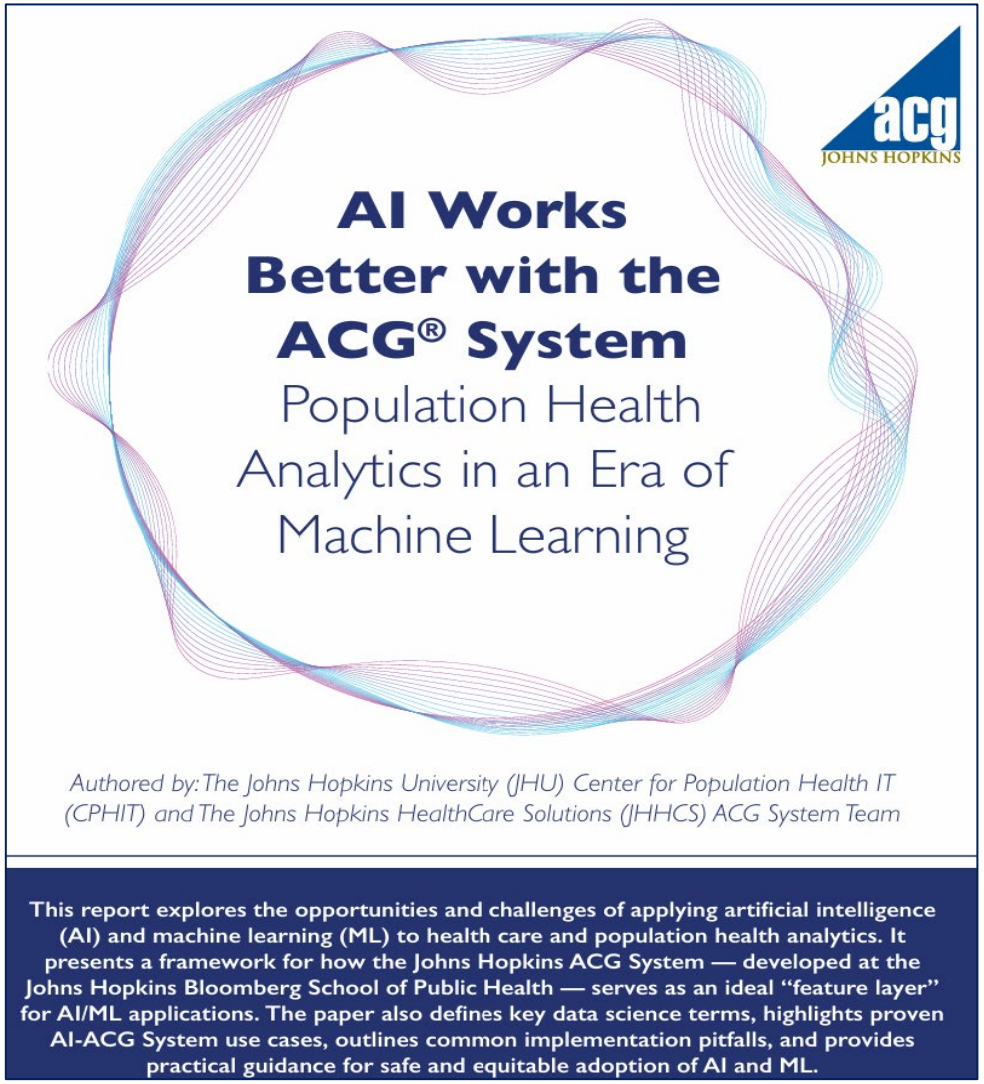
The Johns Hopkins ACGs – The Optimal **"Feature Layer"** for Deep Learning AI to Predict Key Population Health Outcomes





AI Works Better with the ACG System

Scan QR code to download the white paper

Why AI is Better with the ACG System

Efficiency & Scale

- 30+ years of human and machine optimization
- Risk-stratify millions of patients more effectively than ML alone
- Processable across hundreds of millions of daily patient records globally

Prevents Spurious Associations

- Top-down ACG feature layer prevents bottom-up bias from dragging down results
- Protects against data missingness and systematic bias
- Maintains validity and transparency when combined with AI techniques

Interpretability & Trust

- Clinicians understand the clinical rationale behind each prediction
- Transparent risk scores (not black-box outputs)
- Fosters adoption and appropriate clinical use

Proven Track Record

- 12,000+ peer-reviewed academic papers
- 30+ years of real-world validation
- Widely used population health methodology globally (250M+ patients, 23+ nations)

Four Key Implementation Challenges of AI and how ACG helps overcome them

1- Algorithmic Bias

- AI: Under-representation in training data → inequitable predictions
- **With ACG:** Solution (brief): ACG-centric bias audit + stratified calibration

2- Data Fragmentation

- AI: Missing/conflicting codes → reduced signal
- **With ACG:** ACG's clinically validated aggregation logic

3- Black-box Opacity

- AI: Opaque models → clinician distrust
- **With ACG:** 200+ markers, 15+ models

4- Over-fitting & Portability

- AI: Models may not transfer across sites
- **With ACG:** Transportable features + reference comparators

Case Study 1: Targeted Care Management

Challenge: Pressures to deliver personalized, timely care with the right resources.

ACG System Supported Solution: The ACG System's population segmentation tool (Patient Need Groups) is used to create targeted care management lists based on clinical profiles that are overlayed with AI for personalized messaging and SMART alerts.

Result: **SMART alerts connect the right patients to the right resources at the right time** – the result is more efficient resource allocation and increased patient engagement.

Source: JHU ACG White Paper 2025 – https://www.hopkinsacg.org/wp-content/uploads/2025/10/Johns-Hopkins-ACG-System_AI-Works-Better-with-ACG-System-v101725.pdf

Case Study 2: Intelligent Care Recommendations

Challenge: Care managers are overwhelmed by patient complexity when designing interventions that meet individual patient needs.

ACG System Supported Solution: **AI generates tailored recommendations and well-being** tips via the patient app, informed by ACG System risk markers, identification of comorbidities, predicted health costs and medication adherence, combined with patient personality type and defined health goals.

Result: Significant reduction in care planning time while improving the consistency and quality of interventions, based on clinically defined population health needs.

Case Study 3: Model Selection Improvement

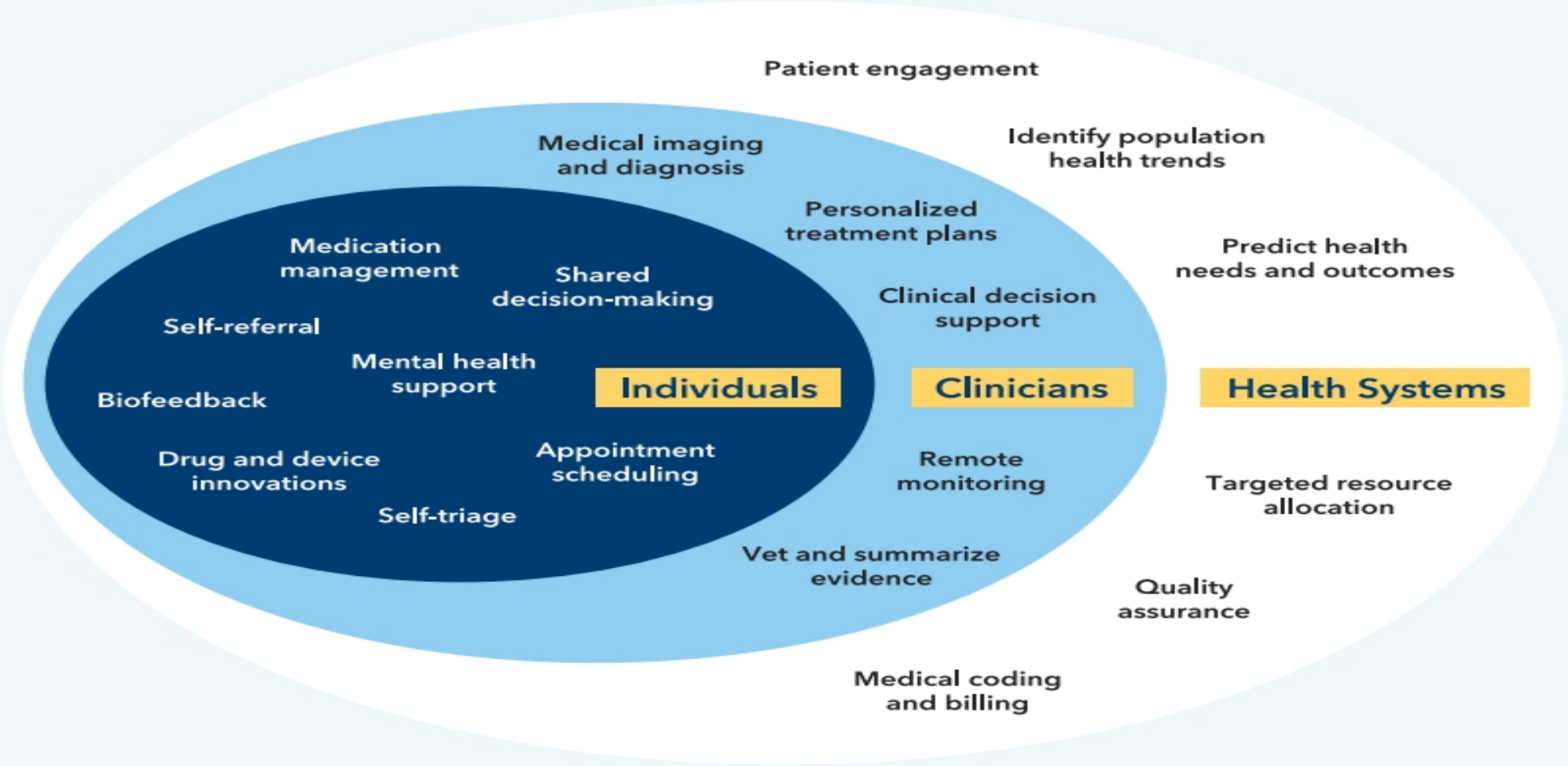
Challenge: **Identifying which ACG System risk markers and models are the best fit** for analytic needs.

ACG System Supported Solution: ACG System outputs (e.g., risk model scores, PNG segmentation categories, Resource Utilization Bands, etc.) can be input to AI models, improving their predictive accuracy and clinical explainability.

Result: Augmented information and explainable ACG System outputs support the delivery of tailored patient care.

Issues to Consider & Pragmatic Suggestions for the Path Forward

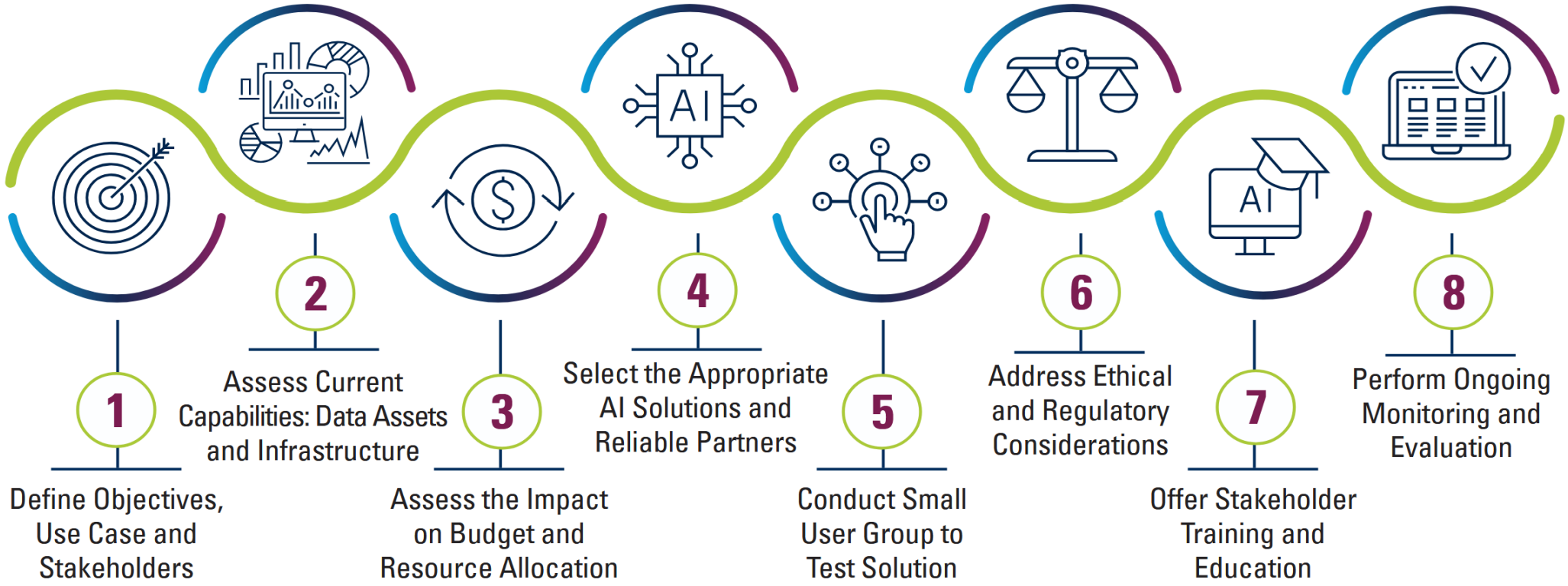
How might different stakeholders use AI to improve health outcomes and care delivery?



Source: Kaiser Permanente 2024 - https://www.kpihp.org/blog/ai-in-health-care-current-applications-and-policy-opportunities/

Key Implementation Stages of Major AI/ML Innovations

it's more than "clicking a button" or "filling-in a "prompt"



Adapted from the American College of Cardiology 2025 https://www.acc.org/About-ACC/Innovation/Artificial-Intelligence/AI-in-Health-Care-Tools

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Key Takeaways Relevant to Future AI Application in Population Health and Health Care

1. **Human/machine collaboration is essential**
   - Subject matter expertise and context must be central to the Ai application
   - Measures / features and constructs must be meaningful to all parties
   - Focusing on use case impact and feasibility is key

2. **It's <u>not</u> just about analytics, data preparation and curation is even more important than before**
   - AI cannot fully compensate for inaccurate, incomplete or biased data

3. **Text mining (NLP)** and "ambient AI" will be critical innovation area given current state of EHRs

AI in Health Care Analytics Takeaways - Cont.

4. AI can offer potential **advantages, but this should be balanced** against, increased bias and lack of transparency, both of which must be addressed
5. Today the focus has been on big data and analytics, but there will also be **huge AI impact in other health care areas** such as:
   - Clinician and patient diagnosis / knowledge management using LLM
   - Radiology / imaging with limited clinician involvement
   - Medical robotics and smart devices
   - "Robotic" automation of back-office workflow
   - Agentic AI support our daily administrative / programming tasks
6. The **technology and business of AI should not take priority over the social/human side** of the health care mission. Our journey will be a critical and interesting one!

Next Steps

- Download the white paper
- Learn more about the ACG System: hopkinsacg.org
- Connect with CPHIT at the Johns Hopkins Bloomberg School: publichealth.jhu.edu/center-for-population-health-information-technology

Questions?

Thank you!

For more information, please contact us at **acginfo@jh.edu** or visit **hopkinsacg.org**.