

Artificial Intelligence in Healthcare

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MHA621
Healthcare Informatics

Lecture 10



Intended Objectives

1. Learn three healthcare analytics types (Descriptive, Diagnostic, Predictive) and their uses.
2. Explore AI methods (Expert Systems, ML, Neural Networks) in healthcare.
3. Study AI clinical uses, like disease detection and virtual therapy.
4. Understand AI in operations, e.g., discharge planning and claims automation.
5. Discuss AI ethics, including bias, transparency, and regulations.

Levels of Data Analytics in Healthcare



➤ Types of Healthcare Analytics

- Descriptive Analytics.
- Diagnostic Analytics.
- Predictive Analytics.

Types of Healthcare Analytics



Descriptive
Analytics



Diagnostic
Analytics



Predictive
Analytics

Healthcare Analytics

1. Descriptive Analytics:

■ **Function:**

- Understand past events using current and historical data.

■ **Tools:**

- Patient records, operational reports.

■ **Importance:**

- Measures hospital performance and identifies general healthcare trends.

Healthcare Analytics

2. Diagnostic Analytics:

- **Function:**

- Identify the causes of healthcare-related problems.

- **Outcomes:**

- Discover the causes behind issues like high post-operative infection rates.

- **Benefit:**

- Enables preventive action based on insights.

Healthcare Analytics

3. Predictive Analytics:

■ **Function:**

- Forecast future outcomes.

■ **Tools:**

- Artificial Intelligence (AI) and Machine Learning (ML).

■ **Benefit:**

- Enables proactive planning and enhances care quality.

Introduction to AI



Introduction to AI

➤ What is AI?

- Definition: Machines mimicking human decision-making.
- Quote from Andrew Ng: "AI can perform tasks humans decide in <1 second."
- Donald Knuth's perspective: AI excels at "thinking" tasks but struggles with reflexive actions (e.g., catching a ball).

AI Categories: Methods & Applications

Chapter

10

➤ AI Methods:

1. Expert Systems: Rule-based logic (e.g., early diagnostic tools).
Ex.: *If* the patient has a high fever and positive blood culture, suggest antibiotics for bacterial infection.
2. Machine Learning: Learns from patterns in data (e.g., predicting readmission).
3. Neural Networks: Mimics brain structure to solve complex tasks (e.g., image recognition).

➤ AI Applications:

1. Natural Language Processing (NLP): enables computers to understand, interpret, and generate human language.
2. Robotics: combines mechanical systems with AI algorithms to perform tasks with physical movement and environmental interaction.
3. Predictive Analytics: Uses statistical models and machine learning to forecast future outcomes based on historical data.

1. AI Strengths:

1. Solves complex equations quickly (e.g., differential equations).
2. Analyzes massive datasets (e.g., retinal scan analysis for heart disease prediction).
3. Operates 24/7 without fatigue (e.g., RPA in insurance claims follow-up).

2. Human Strengths:

1. Reflexive actions (e.g., catching a ball, complex motor skills).
2. Emotional intelligence & ethics (e.g., palliative care, nuanced patient needs).
3. Nuanced pattern recognition: *"Chihuahua or Muffin"* problem illustrates AI struggles with visual ambiguity.



Clinical Applications of AI



1. Clinical Decision Support Systems

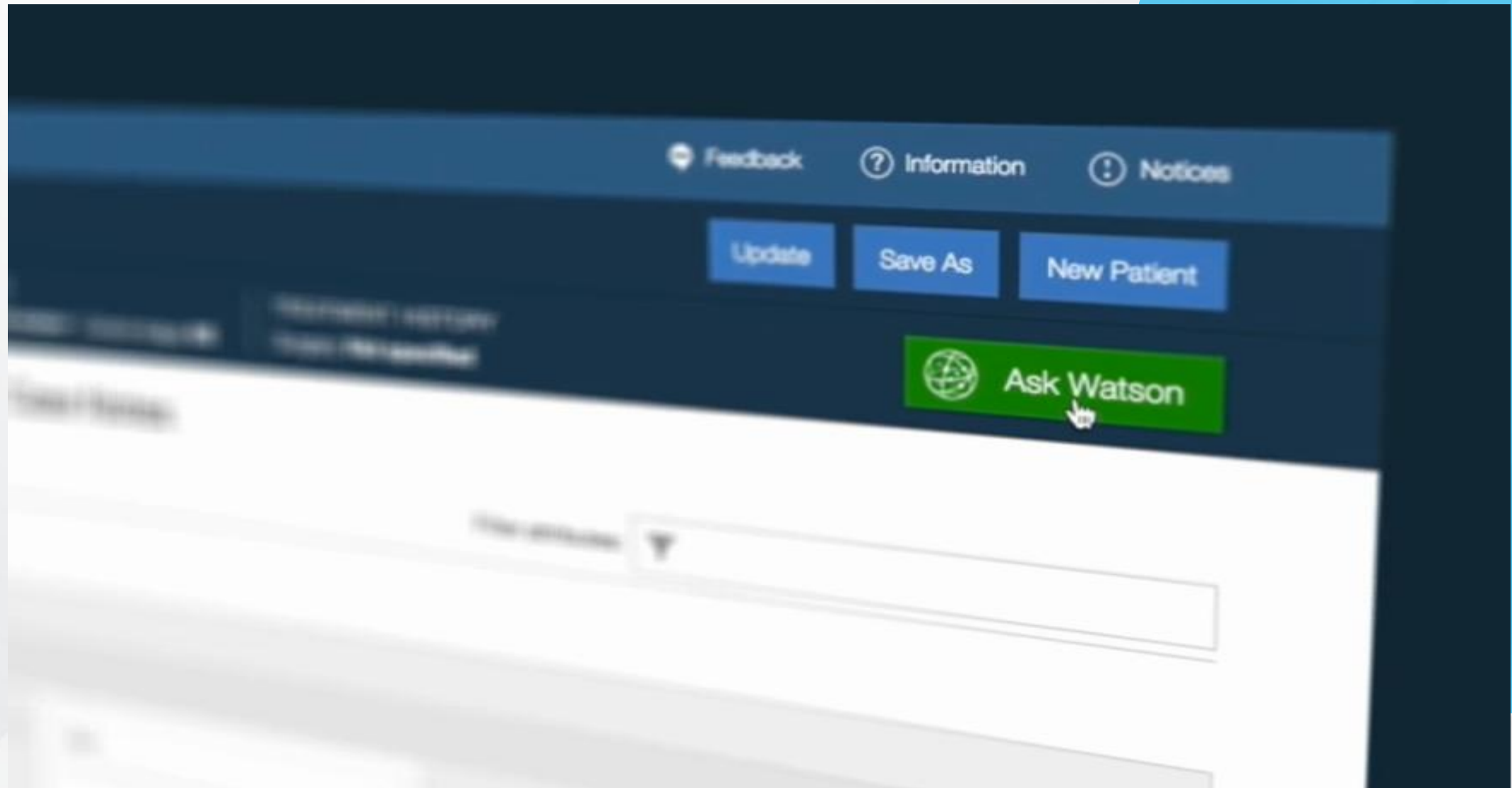
➤ Main Function:

- Analyze patient data against large medical databases
- Provide evidence-based treatment recommendations

➤ Micromedex with IBM Watson:

- Delivers accurate, comprehensive drug and disease information.
- Enhances the speed and quality of clinical decision-making.





IBM Watson for Oncology
Feedback
Information
Notices

Patient Cases / Stage IIB neoadjuvant with Case Notes
Update
Save As
New Patient

View more
DEMOGRAPHICS
Age: 62 Gender: Female Performance status: 0
DISEASE STATUS
Cancer type: Breast cancer Cancer stage: IIB
TREATMENT HISTORY
Surgery: Not specified
Ask Watson

Back to clinical information

Treatment Plan Options for: Stage IIB neoadjuvant with Case Notes

Select a clinical trial
Chemotherapy followed by surgery followed by endocrine therapy and radiation therapy
More treatment plan options

Chemotherapy followed by surgery followed by endocrine therapy and radiation therapy

Timeline for Treatment Plan (shown in years)

Chemotherapy
Surgery
Endocrine
(Radiation)

2 3 4 5 6 7 8 9 10

Recommended For Consideration Not Recommended

Select treatment options

Chemotherapy	Surgery	Endocrine	Radiation
Dose-dense AC (Doxorubicin / Cyclophosphamide) followed by T (Paclitaxel)	Referral to surgery	Letrozole at least 5 years Anastrozole at least 5 years	Referral to radiation oncology
TAC (Docetaxel / Doxorubicin / Cyclophosphamide)		Tamoxifen	
AC (Doxorubicin / Cyclophosphamide) followed by Docetaxel			
EC (Epirubicin / Cyclophosphamide) followed by T (Paclitaxel)			

2. *Detecting Diabetic Retinopathy with AI*

- **Diabetic Retinopathy:** A diabetes-related eye disease that can cause blindness.
- **IDx-DR:** First FDA-approved AI tool to detect it.
 - Analyzes eye images from a special camera.
 - Gives results without a doctor needing to interpret them.
 - Detected disease correctly in 87.4% of cases.
 - Identified healthy cases correctly in 89.5%.
- **Benefit:** Makes screening easier in primary care clinics.

3. AI in Radiology: Breast Cancer Detection

- **Google AI model:** Trained on thousands of mammograms.
 - Detect breast cancer earlier and more accurately.
 - Missed fewer cancers (↓9.4% in the US).
 - Made fewer false alarms (↓5.7% in the US).
 - UK radiologists said it could reduce their workload by 88%.
- **Takeaway:** AI can assist radiologists, save time and improve accuracy.

4. *Predicting Heart Disease from Eye Images*

- **Deep Learning AI:** Analyzed retinal (eye) scans of over 284,000 people.
 - Discovered: Subtle eye features linked to heart disease risk.
 - Why it matters:
 - Doctors could not previously detect these patterns.
 - AI finds hidden clues humans might miss.
- **Future potential:** Fast, non-invasive screening of heart disease risk using eye scans.

5. Virtual AI Therapist: “Ellie”

- **Ellie:** A virtual therapist developed for returning war veterans.
- What Ellie does:
 - Makes eye contact, nods, and responds like a human.
 - Pauses to encourage patients to talk more.
 - Doesn't give therapy: instead, collects data to help real therapists.
 - Offers a sense of privacy.
 - Helps patients who feel shy or uncomfortable talking to people.
- Quote: *“After the second question, you forget it's a robot.”*

Operational and Administrative AI



1. *AI Prediction of Discharge Delay Effects*

- **Problem:** Discharges get delayed due to bottlenecks (e.g., late physical therapy sessions, test results).
- **AI Solution:**
 - Analyzes historical data (e.g., patient condition, staff availability, past delays).
 - Flags high-risk cases early (e.g., "Patient X likely needs therapy scheduling 24hrs earlier to avoid delay").
- **Example:**
 - AI alerts staff if a post-surgery patient's recovery pace suggests they'll miss discharge goals without faster physical therapy.

2. *"Nudges" for Resource Prioritization*

➤ What are "Nudges"?

- Simple definition: AI-driven gentle prompts or alerts to guide staff decisions without forcing actions.
- Analogy: Like a GPS suggesting a faster route—you can ignore it, but it optimizes efficiency.

2. *"Nudges" for Resource Prioritization*

➤ What are "Nudges"?

- How It Works:
 - AI identifies urgent needs (e.g., MRI for stroke patients) and "nudges" schedulers to prioritize them in queues.
- Example:
 - **Without Nudge:** MRI schedule first-come, first-served.
 - **With Nudge:** AI bumps a critical case to the top, reducing wait times for high-risk patients.

- **AI leverages** predictive analytics, smart automation, and behavioral nudges to optimize healthcare workflows.
- **Outcome:** Faster, data-driven decision-making that reduces costs, minimizes errors, and decreases delays across both patient care and administrative workflows.
- **Example:** *An AI prompt like "80% of similar patients benefited from earlier PT, schedule now?"*



3. Automating Claims Follow-Up with RPA

- **Application:** AI-driven Robotic Process Automation (RPA) eliminates manual work.
- **How it Works:** Bots handle repetitive tasks like claims status checks and data entry.
- **Result:** Processing time drops from 10 minutes to just 1 minute per claim.

4. *AI-Optimized Claims Matching*

- **Application:** AI analyzes claims and automatically assigns them to nurses based on expertise.
- **How it Works:** Machine learning matches claims (e.g., surgery, chronic care) with the right specialist.
- **Result:** Approval rates jump from 43% to 57% with fewer errors and faster payouts.

- **Speed:** Near-instant follow-ups vs. slow manual checks.
- **Accuracy:** AI ensures the right person handles each claim.
- **Cost Savings:** Less rework, fewer delays, happier customers.

AI and RPA turn claims processing from a slow, error-prone task into a fast, intelligent system so, cutting costs and boosting efficiency.



Challenges and Ethical Considerations



1. *Data Bias in AI*

➤ Risk:

- AI systems trained on non-representative or limited datasets can lead to biased outcomes.
- May result in unequal treatment across different patient groups (e.g., by race, gender, or age).

➤ Fix:

- Use diverse, inclusive datasets that reflect the full patient population.
- Implement regular audits and validations to detect and correct biases.
- Involve interdisciplinary teams to review AI outputs for fairness and accuracy.

2. *Black Box Problem in AI*

➤ Lack of Transparency:

- AI systems may make recommendations without explaining the reasoning behind them.
- Clinicians often cannot trace how the AI reached a specific decision.

➤ Example:

- An AI tool recommends chemotherapy for a patient, contradicting the oncologist's clinical judgment.
- Raises concerns about over-reliance on AI without understanding the context.

2. *Black Box Problem in AI*

➤ Need for Human Oversight:

- Essential to have options for human override in critical decisions.
- AI should support, not replace, clinical expertise.

➤ Call for Explainable AI:

- Transparency in algorithms is needed to build trust.
- Clinicians should be able to interpret and validate AI recommendations.

3. *Regulation and Classification*

➤ AI as a "Medical Device":

- Debate on whether AI should be classified as a medical device, which would require oversight from regulatory bodies like the FDA.
- Such classification would ensure safety, efficacy, and accountability in AI systems used for medical purposes.

3. Regulation and Classification

➤ **Dynamic Regulation for Adaptive AI:**

- The need for evolving regulations to accommodate the flexibility and adaptability of AI systems.
- AI technology is continuously improving, requiring a regulatory framework that can adapt to new capabilities and applications in healthcare.

The Informatics Paradigm Shift

Moving from passive repositories to active drivers of clinical strategy

The “Back-Office” Era

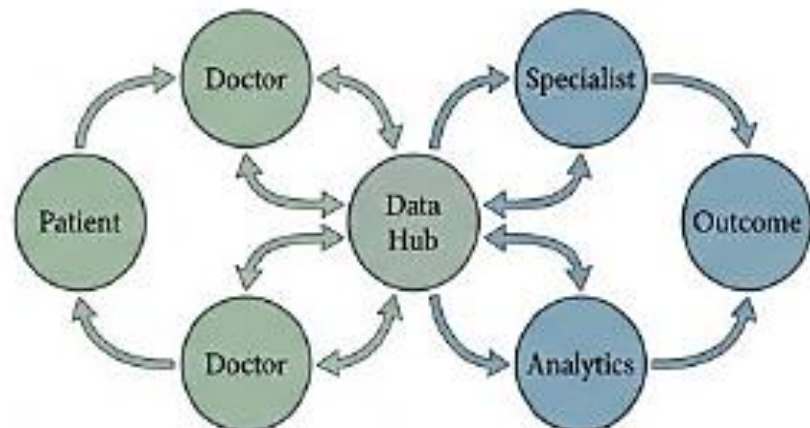
Trait: Passive and Reactive



Limited entirely to static data storage and isolated electronic health records (EHR).

The Strategic Clinical Driver

Trait: Dynamic and Predictive

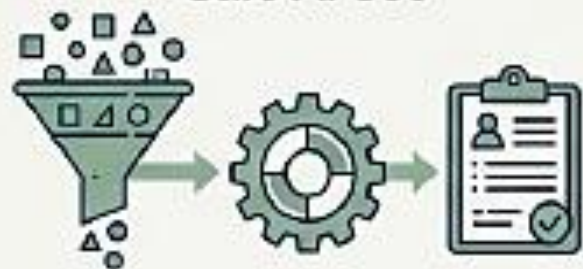


An active, intelligent architecture integrated directly into frontline patient care and operational workflows.

Healthcare informatics is no longer a localized IT function—it is the foundational infrastructure of modern practice.

The Four Pillars of Practical Application

Safe AI Use



Deploying artificial intelligence to safely augment clinical decision-making.

Cybersecurity & Data Protection



Defending patient privacy and system integrity against modern digital threats.

Modern Informatics

Interoperable Health Information Exchange



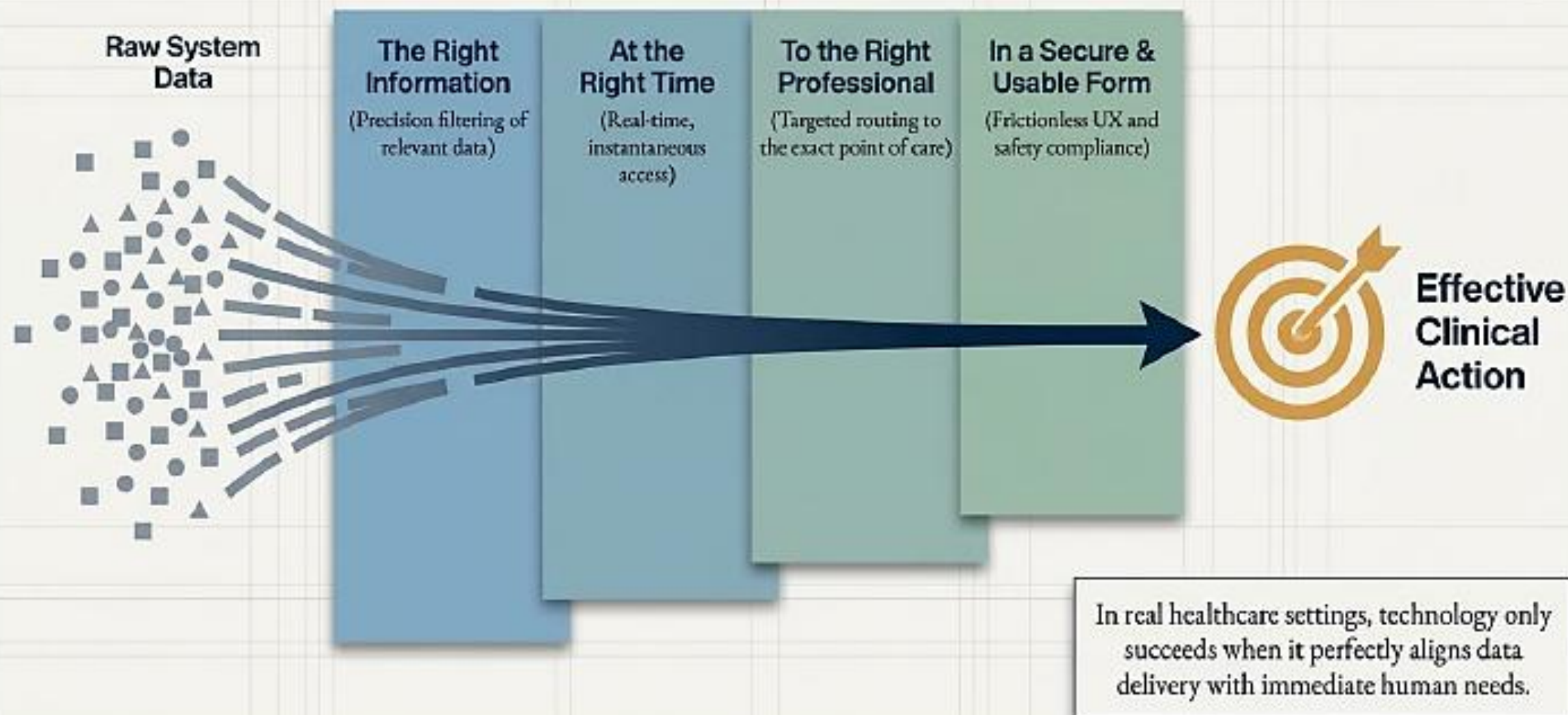
Eliminating data silos through seamless, system-to-system communication.

Telehealth-Supported Continuity

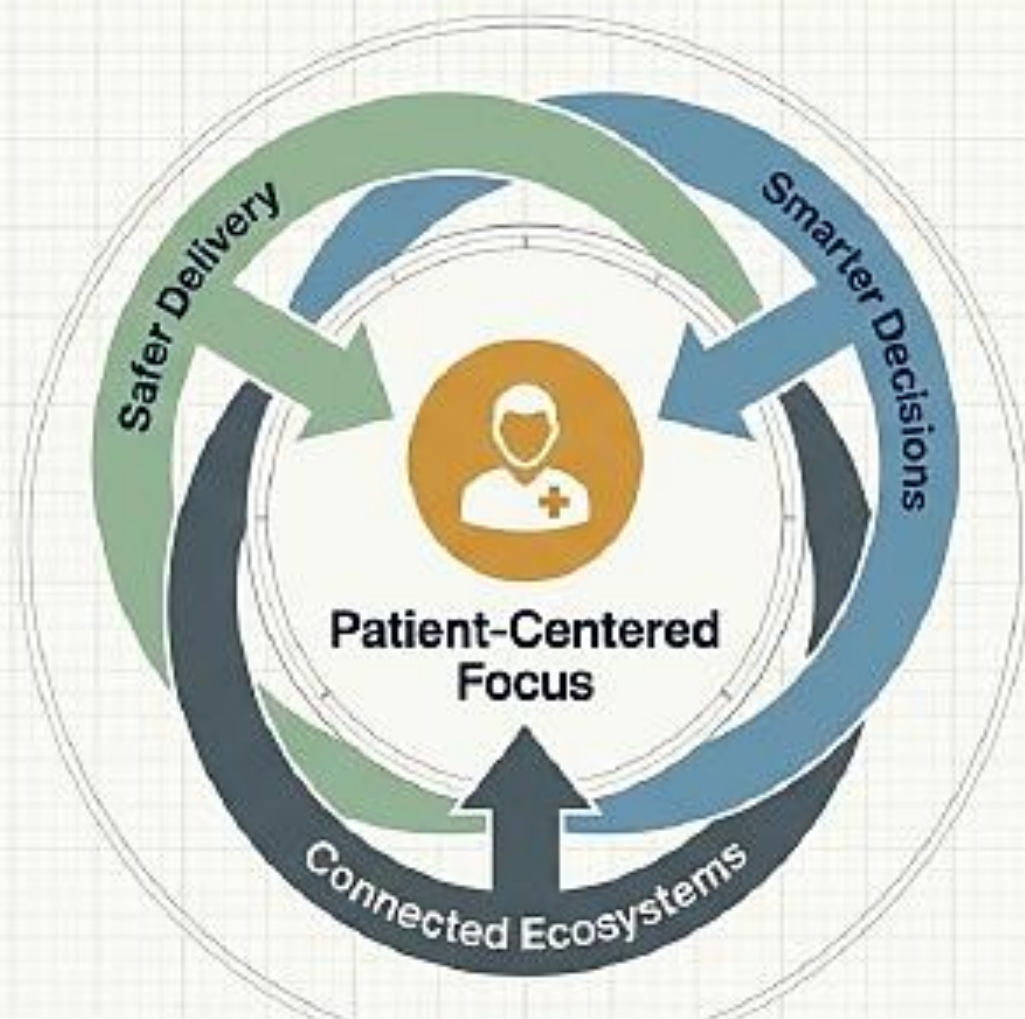


Extending the reach of care beyond hospital walls to maintain continuous patient engagement.

Operational Reality: The 'Right' Alignment



The Central Nervous System of Modern Medicine



Healthcare informatics is now the core driver of safer, smarter, more connected, and profoundly patient-centered healthcare delivery.

1. Descriptive analytics reviews past data; diagnostic finds causes; predictive forecasts trends.
2. AI boosts data tasks (imaging, claims) but lacks human judgment.
3. Clinical AI (e.g., IDx-DR, mammography tools) improves accuracy but needs oversight.
4. Operational AI cuts delays (discharges) and automates tasks (RPA).

Wrap Up

5. Bias risks exist; fix them with diverse data and audits.
6. "Black box" AI needs Transparency and human checks.
7. Regulations must adapt to ensure AI safety and fairness.
8. AI supports, not replaces, human expertise in healthcare.

9. Healthcare Informatics in Modern Practice:

- Healthcare informatics is no longer limited to data storage or electronic records
- Its current practical application now includes:
 - safe AI use
 - interoperable health information exchange
 - cybersecurity and data protection
 - telehealth-supported continuity of care



Thank You