

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



Healthcare Analytics

➤ 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 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



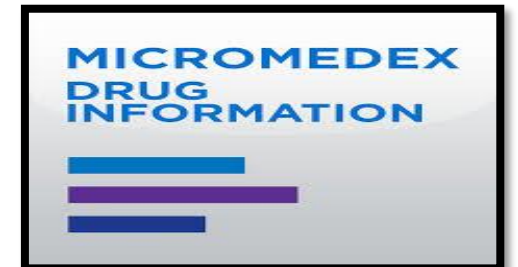
1. Clinical Decision Support Systems

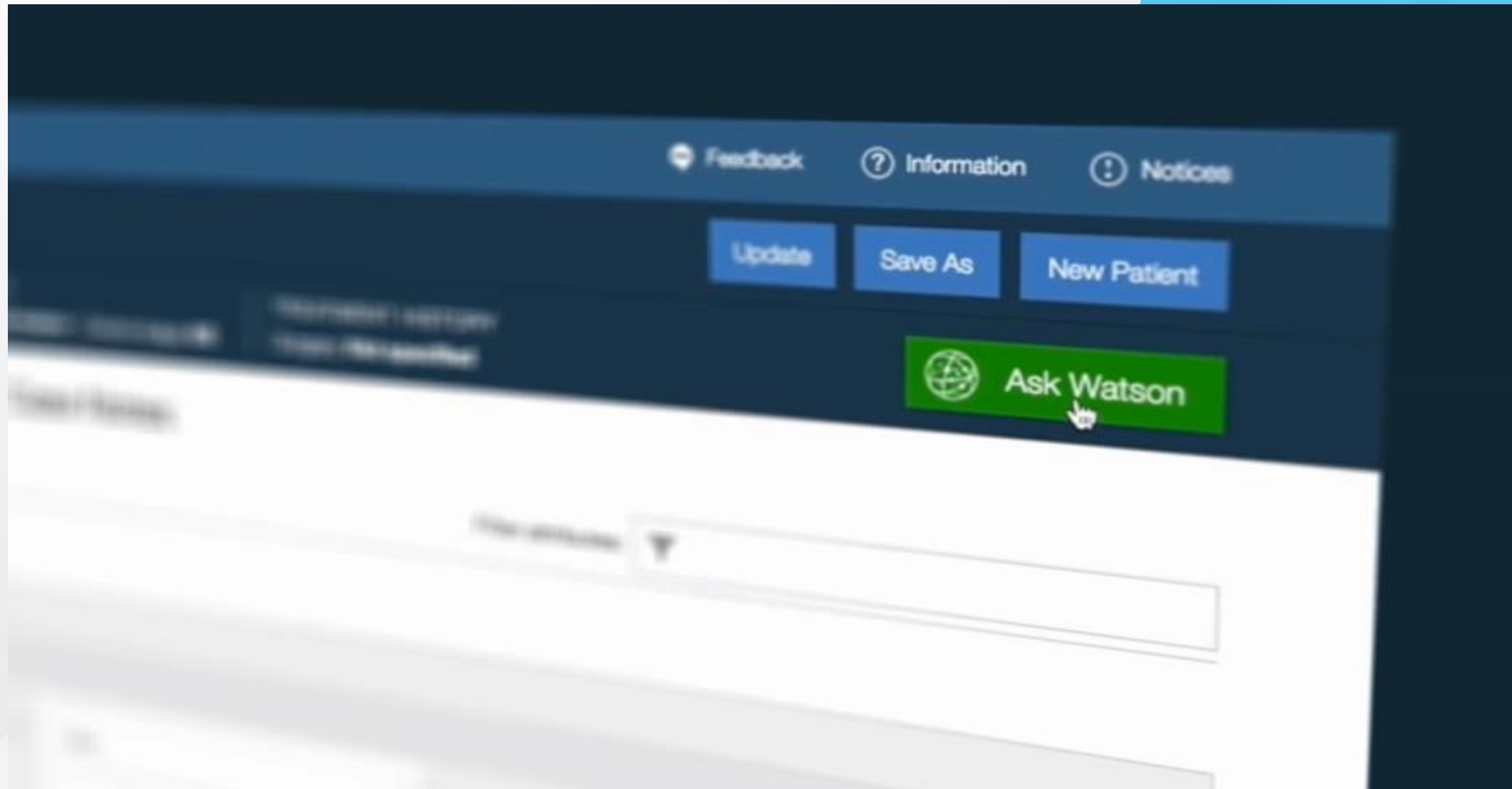
➤ Main Function:

- 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

Treatment Options

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, saving time and improving 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 heart risk screening 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**.

The Impact of AI & RPA

- **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.

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.



Thank You