**Webinar notes:**

- Audience is muted during the presentation.
- Please enter your questions into the chat box.
- Please fill out the post-webinar survey.
- Webinar is being recorded.
- A link to the recording will be posted on: 
  - AzCRH [www.crh.arizona.edu](http://www.crh.arizona.edu)
Land Acknowledgement

We respectfully acknowledge the University of Arizona is on the land and territories of Indigenous peoples. Today, Arizona is home to 22 federally recognized tribes, with Tucson being home to the O’odham and the Yaqui. Committed to diversity and inclusion, the University strives to build sustainable relationships with sovereign Native Nations and Indigenous communities through education offerings, partnerships, and community service.
ROLE OF AI IN HEALTH CARE

Srikar Adhikari, MD
DISCLOSURES

- NIH (grant funding)
- Department of Defense (grant funding)
- Emergency Medicine Foundation grant funding
- Springer (Book Royalties)
- Consulting relationship:
  - GE Ultrasound
  - EXO Ultrasound
OBJECTIVES

- AI in Healthcare
- Benefits
- Challenges
- Ethics
$15 Billion in 2023

$103 Billion by 2028

$300 Billion in savings in healthcare in the next 5 years
Machine learning (neural networks & DL)
Natural language processing
Rule-based expert systems
Physical robots
Robotic process automation
AI-HEALTH CARE

- Real time analytics
- Workforce shortages
- Public health surveillance systems
- Wait times
- Improved preventive measures
- Cost savings
- Drug Discovery
AI-HEALTH CARE

- Diagnostic interpretation
- Clinical decision-making
- Workflow
- Predictive algorithms
- Health monitoring
STAKEHOLDERS

- Patients and Families
- Clinician Care Teams
- Public Health Program Managers
- Business Administrators
RURAL/RESOURCE LIMITED SETTINGS

- Access
- Inequities
- Higher morbidity & mortality
- Life expectancy
AI-FAIRNESS IN HEALTH CARE
AI-HEALTH CARE

- Increased access
- Increased affordability
- Quality of health care
DIGITAL INFRASTRUCTURE EFFICIENT HEALTH ECOSYSTEM
Impact of AI and ML on Select Healthcare Outcomes in 2022 According to US Healthcare Executives

% of respondents

- Improving clinical outcomes
  - Very effective: 23%
  - Often effective: 36%
  - Sometimes effective: 35%
  - Rarely effective: 7%
  - Never effective: 7%

- Improving operational performance
  - Very effective: 19%
  - Often effective: 39%
  - Sometimes effective: 36%
  - Rarely effective: 7%

- Improving health system efficiency
  - Very effective: 17%
  - Often effective: 36%
  - Sometimes effective: 37%
  - Rarely effective: 9%

- Improving administrative performance
  - Very effective: 13%
  - Often effective: 33%
  - Sometimes effective: 36%
  - Rarely effective: 16%
  - Never effective: 2%

- Improving financial outcomes
  - Very effective: 12%
  - Often effective: 35%
  - Sometimes effective: 39%
  - Rarely effective: 13%
  - Never effective: 1%

- Improving consumer engagement
  - Very effective: 12%
  - Often effective: 33%
  - Sometimes effective: 45%
  - Rarely effective: 8%
Medical diagnosis and decision-making
Patient engagement and education
Mental health support
A. A Request to GPT-4 to Read a Transcript of a Physician–Patient Encounter and Write a Medical Note

Clinician: Please have a seat, Mr. X. Thank you for coming in today. Your nutritionist referred you. It seems that you and your mom have some concerns. Can you sit down and we will take your blood pressure and do some vital signs?

Patient: I guess I do need to get back to my report to study. I have a tough math coming up on Monday that I am struggling for. I am never

Clinician: How many credits are you taking and how are classes going?

Patient: 12 credits. I am at the top of my class. Could we get this done? I need to get back.

Clinician: How often and do you take a rest training now? You are 28, correct?

Patient: Yes. I run nine miles every day.

Clinician: Your BP is 120/80. Your pulse is 72. How much have you been eating?

Patient: I have been eating fine. I talked to the nutritionist about this earlier.

Clinician: Let's have you stand up and face me and I will back you write on the scale. Ears me please. Thank you, and now for a height. Oh looks like 5'3". So ahead and have a seat.

Patient: How much? Can I please see what the scale says? I'm fat.

Clinician: Please sit up and I will listen to your heart and lungs.

Patient: Fine.

Clinician: You know that this is not a positive part of your treatment. We have discussed this before. You are here today because your nutritionist and your mom are both concerned about you. You are very 18, Mr. X.

Patient: I know, I am fine. I am eating well. I tell my mom what I eat, just because I am not fat like she is.

Clinician: How have you felt? Are you feeling sad or depressed? Last time we talked, you were quite unhappy. Are you feeling suicidal?

Patient: I am busy and not concerned about happiness. I need to train and I am tired of everyone nagging me about what I eat and how much I eat. I am the smartest in my class and one of the best runners on the team. I don't have time for all of this. I only have to keep my mom off my back.

Clinician: When you were here last, you agreed to keep working with your nutritionist and being open with your mom and me. We need to work together to help you get well. There are irregularities in your heart and I noticed the downy hair on your back and arms.

Patient: I will work with you, I know. I don't want to be like this. I need to run. It helps me.

Clinician: When you were in treatment, we were watching toward some goals with your cognitive behavioral therapy. We need to revisit those goals. First thought, we need to bring your mom in and have a discussion about the next step to help you get well. I would like to do more tests to check your electrolytes and your blood count.

Patient: Oh, I do want to be better.

Clinician: I want you to feel better and be healthy. Let's have your mom come in, ok?

Patient: Yeah.

Please summarize this encounter in the form of the doctor's medical note.

GPT-4: Patient is a 18-year-old male with a history of severe depression and anxiety. She is referred by her nutritionist and accompanied by her mother. She is taking 20 credits at college and is a competitive runner. She is in debt for her loans and has poor health due to her situation. She is worried about treatment and nutrition. She reports eating fine, but she is severely underweight (BMI < 18.5). She has signs of malnutrition and eating disorders. She does not feel well, but expresses her need and lack of interest in happiness. She has a strong attachment to running, but feels it helps her cope. She agreed to work with her nutritionist, her mother, and me. She needs more support and monitoring. I ordered some blood tests and suggested a review of her cognitive-behavioral therapy goals. I discussed with her and her mother the possibility of hospitalization or outpatient treatment if her condition does not improve.

B. Use of GPT-4 to Review and Validate a Proposed Medical Note

Clinician: Can you check the proposed note and identify any facts in it that don't appear explicitly in the transcript?

- The entire transcript and medical note in Panel A is correct at this point.

GPT-4: There are a few facts in the proposed note that are not explicitly stated in the transcript, such as:

- The patient's BMI, which is calculated from her weight and height, but not mentioned in her or the mentioned by the clinician.

The note should indicate that the BMI is based on the clinician's measurements or estimate.

- The signs of malnutrition and eating disorders, which are not specified or explained by the clinician. The note should list the specific signs, such as the downy hair, irregular rhythms, low blood pressure, and low pulse.

- The blood tests that the clinicians ordered, which are not specified or explained by the clinician. The note should mention what tests were ordered and why, such as electrolytes, blood count, or liver function.

Clinician: Thanks. The patient's weight was 87 by. For the blood test, I ordered CBC with RBC and peripheral smear. Can you check the note accordingly?

GPT-4: Sure. Here is a possible revision:

Patient is a 18-year-old male with a history of severe depression and anxiety. She was referred by her nutritionist and accompanied by her mother. She is taking 20 credits at college and is a competitive runner. She is in debt for her loans and has poor health due to her situation. She is worried about treatment and nutrition. She reports eating fine, but she is severely underweight (BMI < 18.5) and has signs of malnutrition and eating disorders. She does not feel well, but expresses her need and lack of interest in happiness. She has a strong attachment to running, but feels it helps her cope. She agreed to work with her nutritionist, her mother, and me. She needs more support and monitoring. I ordered a CBC with RBC and peripheral smear to assess her anemia and possible bone marrow suppression. I suggested a review of her cognitive behavioral therapy goals. I discussed with her and her mother the possibility of hospitalization or outpatient treatment if her condition does not improve.
Clinician: I have a patient with a history of chronic obstructive pulmonary disease (COPD) who is experiencing shortness of breath. What should I be looking for to determine whether this patient is having an exacerbation?

GPT-4: As a health care provider, when evaluating a patient with a history of COPD who presents with shortness of breath, you should be looking for signs and symptoms of an exacerbation. An exacerbation of COPD is defined as an acute worsening of respiratory symptoms beyond the patient's usual day-to-day variation and is typically characterized by increased cough, increased sputum production, and increased dyspnea.

Some of the key clinical features that suggest an exacerbation of COPD include:
1. Increased shortness of breath, cough, and sputum production.
2. Increased wheezing, chest tightness, and chest discomfort.
3. Changes in the color, amount, and thickness of the sputum.
4. Increased use of rescue medication, such as short-acting bronchodilators.
5. Fatigue, confusion, or altered mental status.
6. Cyanosis, a bluish discoloration of the skin or lips, due to inadequate oxygenation.

It is important to note that other medical conditions can mimic an exacerbation of COPD, such as congestive heart failure or pulmonary embolism. Therefore, it is essential to perform a thorough evaluation, including a detailed history, physical examination, and diagnostic testing, to confirm the diagnosis and identify any potential underlying causes.

Prompt recognition and appropriate management of COPD exacerbations are critical to minimizing their impact on the patient's quality of life and overall prognosis. If you suspect that your patient is having an exacerbation, you should consult with a pulmonologist or respiratory therapist to develop an appropriate treatment plan, which may include oxygen therapy, inhaled bronchodilators and corticosteroids, and antibiotics for suspected bacterial infections.

Clinician: There is no sputum production. But the patient reports fatigue and there is evidence of cyanosis.

GPT-4: If your patient with a history of COPD is experiencing shortness of breath and fatigue with evidence of cyanosis, this could indicate a severe exacerbation of COPD, which requires urgent medical attention. In this case, it is important to assess the patient's oxygen saturation levels, which can be done with a pulse oximeter, and to provide supplemental oxygen therapy as necessary to maintain a target oxygen saturation level of at least 90%.

The absence of sputum production does not rule out the possibility of an exacerbation of COPD, as not all patients with COPD produce sputum during an exacerbation. However, it is still important to evaluate the patient for any other signs of worsening respiratory distress, such as increased respiratory rate, accessory muscle use, and worsening oxygenation.

In addition to providing supplemental oxygen, the patient may benefit from inhaled bronchodilators and corticosteroids to help relieve symptoms and reduce inflammation in the airways. Antibiotics may also be necessary if there is evidence of a bacterial infection. Close monitoring of the patient's vital signs, oxygen saturation levels, and overall clinical status is important to guide further management and ensure a timely response to any changes in the patient's condition.

It is important to remember that exacerbations of COPD can be life-threatening, and prompt recognition and treatment are essential to improving outcomes for the patient. Therefore, it is advisable to seek the input of a pulmonologist or respiratory therapist for further management and monitoring.
CONVERSATIONAL AI
VIRTUAL ASSISTANTS AND AI CHATBOTS
MENTAL HEALTH

thymia
MEDICAL IMAGING
A small cancer is easy to see

Even a large cancer is hard to see
Epidermal cyst (0.25)
Actinic keratosis (0.16)
Steatocystoma multiplex (0.11)

- AI Metrics
  Malignancy: 15
  Steroids: 0
  Antibiotics: 23
  Antivirals: 0
  Antifungals: 3

Furuncle (0.66)
Folliculitis (0.12)
Epidermitis (0.07)

- AI Metrics
  Malignancy: 13
  Steroids: 0
  Antibiotics: 86
  Antivirals: 0
  Antifungals: 0
POINT-OF-CARE ULTRASOUND
CARDIAC ULTRASOUND IMAGE ACQUISITION

Expert Guidance

Automated Quality Assessment

Intelligent Interpretation
Make slow circular sweeps until moving anatomy appears.
AI-RETINAL DETACHMENT
PULMONARY EMBOLISM
AI-GUIDED ROBOTIC DEVICES
EMERGENCY DEPARTMENT
AI-EMERGENCY MEDICINE
AI-CHALLENGES
Will Robots replace Human jobs by 2030?
AUTOMATION OF JOBS
AI-CHALLENGES

- Bias
- Privacy
- Security
- Surveillance
<table>
<thead>
<tr>
<th>BIAS</th>
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<tbody>
<tr>
<td>Data bias</td>
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<tr>
<td>Algorithmic bias</td>
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<tr>
<td>AI–clinician interactions</td>
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<tr>
<td>AI–patient interactions</td>
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INTEGRATION & IMPLEMENTATION
The thematic priority areas to enhance AI’s impact on healthcare are:

- **Clinical care and outcomes**: Translation of technologies to improve clinical outcomes.
- **Patient-centered care**: Enhancing patients’ health care experience.
- **Health care quality**: Augmenting quality measurement and improvement.
- **Fairness in AI algorithms**: Impact on health disparities and strategies to mitigate bias.
- **Medical education and clinician experience**: Improving clinician training and well-being.
- **Global solutions**: Enhanced care within limitations of low-resource settings.

The continuum of scientific development in artificial intelligence (AI) includes:

- **Discovery and innovation**
- **Prototype testing**
- **Real-world implementation**
- **Clinical evaluation**
ETHICS

♦ Protecting autonomy
♦ Promoting human well-being, safety, and public interest
♦ Ensuring transparency, explainability, and intelligibility
♦ Fostering responsiveness and accountability
♦ Ensuring inclusiveness, and equity
♦ Promoting AI that is responsible and sustainable
# CONSUMERS’ PERSPECTIVES

<table>
<thead>
<tr>
<th>Construct</th>
<th>Construct definition</th>
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<tbody>
<tr>
<td>Perceived performance anxiety</td>
<td>The degree to which an individual believes that AI-based tools and their features exhibit pervasive technological uncertainties.</td>
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<tr>
<td>Perceived communication barriers</td>
<td>The degree to which an individual feels that AI devices may reduce human aspects of relations in the treatment process.</td>
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<tr>
<td>Perceived social biases</td>
<td>The degree to which a person believes that data used in the AI devices may lead to societal discrimination to a certain patient group (e.g., minority groups).</td>
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<tr>
<td>Perceived privacy concerns</td>
<td>The extent to which individuals concern about how AI-based devices collect, access, use, and protect their personal information</td>
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<tr>
<td>Perceived mistrust in AI mechanisms</td>
<td>The degree to which an individual believes that AI models and AI-driven diagnostics and recommendations in health care are still not trustworthy.</td>
</tr>
<tr>
<td>Perceived unregulated standard</td>
<td>The extent to which an individual believes that regulatory standards and guidelines to assess AI algorithmic safety are yet to be formalized.</td>
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<tr>
<td>Perceived liability issues</td>
<td>The extent to which an individual is concerned about the liability and responsibility of using AI clinical tools.</td>
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<tr>
<td>Perceived risks</td>
<td>The extent to which an individual believes that, in general, it would be risky for patients to use AI-based tools in health care.</td>
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<tr>
<td>Perceived benefits</td>
<td>The extent to which an individual believes that AI-based tools can improve diagnostics and care planning for patients.</td>
</tr>
<tr>
<td>Intention to use AI-based tools</td>
<td>The extent to which an individual is willing to use AI-based services for diagnostics and treatments.</td>
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Uncertainty and distrust of AI predictions

- Develop explainable algorithms and transparent model reporting

Regulation and governance of medical AI

- Standardize safe AI practices and establish thorough, transparent reporting performance reporting

Shifts in responsibility introduced by using AI in practice

- Develop frameworks for determining responsibilities and legal liability

Concerns about data privacy and security

- Build infrastructure for safe data sharing

Biased results that hurt marginalized groups

- Measure and mitigate bias throughout the lifecycle of medical AI, from data collection to after deployment
AI IN HEALTH CARE

End-users vs. Educated

Protect patients and other stakeholders

Inaccuracies

Pitfalls and inappropriate application of ML

Unethical and unwanted use of ML
SUMMARY

- Clinical Practice
- Stakeholders
- Workflow
- Efficiency
- Equity
- Safety
- Economic impact