Informatics 442

Revised by

Deema . Fatima . Talal . Ahmed . Mohammed

References

AI in healthcare Summary

LEARNING OBJECTIVES:

- Define the Role of AI in Healthcare
- Identify Key AI Concepts
- Recognize AI Applications in Diagnosis & Treatment
- Discuss Enhanced Patient Care with AI
- Analyze Ethical and Regulatory Aspects
- Anticipate Future AI Trends in Healthcare
- Analyze Case Studies and Real-World Examples

Color index:

Main Text | Female Slides | Male Slides | Extra | **Important** | Dr's Notes (previous notes)| Dr's notes 442 | Golden notes | **Textbook**

Editing file

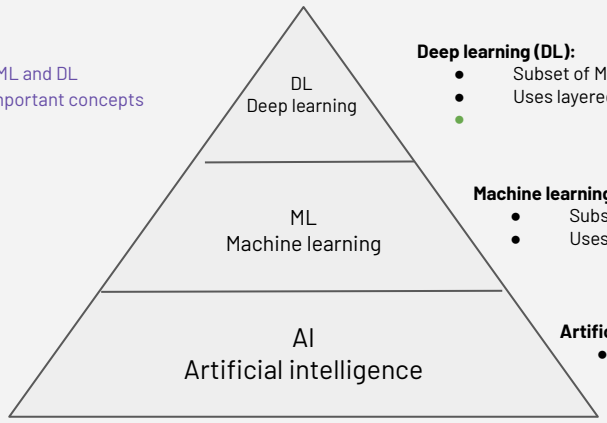
AI(artificial intelligence)

- It's computer system that recognize patterns

AI is a computer system that recognize patterns which allows it to predict events AI does not understand the meaning behind the patterns .
Ai needs input , log sets of data (the more , the better)
So that the system recognize patterns

AI is the umbrella to ML and DL
This slide includes important concepts

Routins > models



Deep learning (DL):
- Subset of ML
- Uses layered artificial neural networks capable of emergently representing latent properties of the data

Machine learning (ML):
- Subset of AI
- Uses statistical algorithm to represent complex patterns within data

Artificial intelligence (AI):
- Stimulation of human intelligence and beyond using programmatic routines

Why use AI in healthcare ?
- Improves patient outcomes
- Automate processes and save time
- Reduce costs

These are examples of where we can use AI in healthcare ?
- Administrative Efficiency
- Predictive analytics
- Diagnosis and disease detection
- Drug and discovery development

Why we use ai ?
Ai is able to analyze large data sets which makes it important and use prediction models to predict what could happen to the patient based on the input data المعطيات

Improve patient outcomes :
If patient is suffered from DM > patients is not complaint to diet > not complaint to medication > AI could predict what could happen to in 6 months (complications) for example and allow physicians to educate the patient and preventing those outcomes

Automate :
Helps us in looking at different patients data in easy manner

Reduce costs :
AI Is costly upon implementation , but helps hospitals save money on the long run

These are examples of where we can use AI in healthcare.
AI applications in 4 fields > important to know
It helps me to predict what could happen in paGents cases depend on the input data

Machine learning is NOT magic

- it learns patterns; it doesn't explain causation.
- it cannot replace clinical experience, domain knowledge, and clinical decisions
- it cannot replace clinical intuition and qualitative assessment
- it cannot handle rare, unpredictable events.

First sentence : Based on the input data , it could tell you that there is a trend but cannot tell you why it occurred , the physicians should be able to analyses that .
Last sentence : Because there was no previous data that was put in the AI system that allows AI >> Learn the pattrens and predict the events .
So AI > has input data > learns the pattern > predicts the event .
So AI > does not have input data (event is rare) > AI cant not predict the event

AI key concepts

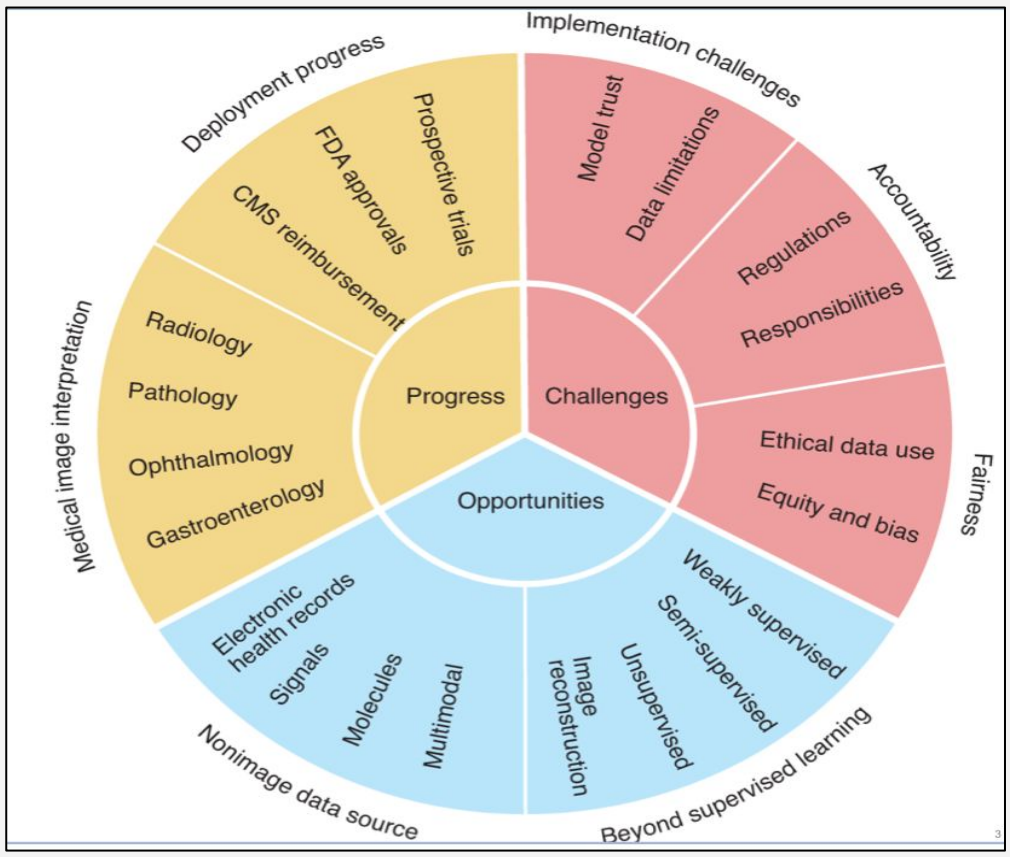
- AI setup beyond supervised learning

Dr said : Know the keywords and you will answer these

Ex: I gave AI numbers Numbers without labels and asked it to 3ind a pattern , these numbers were blood pressure readings , the system was previously programmed to read BP measurements so upon insertion or 120/180 without labeling it , it was still able to recognize that the reading is BP based on pervious readings

Self-supervised learning	Learning from unlabeled data by leveraging information extracted from the data itself
Semi-supervised learning	Learning from a small amount of labeled data combined with a large amount of unlabeled data
Causal inference	Finding the effect of a component or treatment on a system using data
Reinforcement learning	Learning in an interactive environment using feedback from actions and past experiences

Overview of the progress, challenges and opportunities for AI in health



Very important slide doctor said
The only sentences that mentioned are what the doctor focused on :
Deployment progress :
FDA approvals – Prospective trials
Implementation challenges :
1)Model trust : AI outcomes , Ex: ChatGPT is AI when you give chatGPT a query , and it gives you an answer , how much can you trust that the answer is accurate .

2)Data limitations : Ex:rare events > unpredictable , people are different and they have even genetics .
Variations so I don't always have sufficient data to provide to AI "people are unique"

Accountability : 1)Regulations 2)Responsibilities Fairness :
1)Ethical data use :
1- Can We Use The Data?
2- Who Owns The Data?
3- Whohastheauthoritytogiveconsentonusingpatientdata?

2) Equity and bias : could be related to ethnicity (some genes mutations) being more common in black , white or middle eastern people so , there could be bias in the system as for the data we have about the white race being greater than other ethnicity .
Beyond supervised learning : AI can learn from itself .
Weakly supervised – semi supervised – unsupervised – image reconstructions
Noimage datasource : it will be an advantage if the AI can solves the text in electronic health record .
Medical image interpretation : Radiology – pathology

Examples of applications of AI in healthcare

- Radiology (medical image)
- Pharmacy
- Cardiology
- Research
- EHR
- Scheduling
- Sepsis (diagnosis)
- Surgery
- Text
- Strategy
- Speech
- Language translation
- Readmission
- Risk
- Chatbots
- Wearable devices
- education
- Genetic
- Pathology and Histology (analyze slides)
- Socio-demographic
- Dermatology
- Digital assistant
- Screening
- Nuclear medicine
- Face recognition
- Emergency medicine
- Triage
- Faster diagnosis
- Lab tests
- Robotics
- Radiation therapy

Examples of problem and challenges to solves with AI

- Improve diagnosis
- Faster diagnosis
- Reduce errors
- Information retrieval
- Improve patient safety
- Improve treatment
- Faster treatment
- Reduce waiting time
- Self-service and self-care
- Optimize resource usage
- Scheduling and logistics
- Risk stratification
- Better decisions
- Patient privacy
- Communication
- Minimize administrative work
- Improve research
- Improve efficiency
- Reduce bias
- Monitoring
- Expand access
- Patient preparation

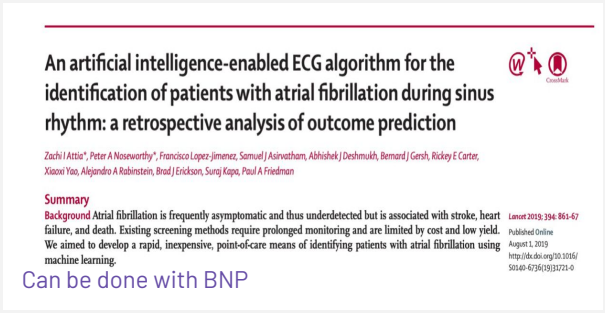
Enhanced patient care with AI

AI application in specific sectors

1) Cardiology

Patterns in 12-lead ECGs AI can read ECG outputs

- Low ejection fraction
- Atrial fibrillation
- Hypertrophic cardiomyopathy
- Cardiac amyloidosis
- Aortic valve stenosis



An artificial intelligence-enabled ECG algorithm for the identification of patients with atrial fibrillation during sinus rhythm: a retrospective analysis of outcome prediction

Zachi I Attia*, Peter A Noseworthy*, Francisco Lopez-Jimenez, Samuel J Asirvatham, Abhishek J Deshmukh, Bernard J Gersh, Rickey E Carter, Xiaoxi Yao, Alejandro A Rabinstein, Brad J Erickson, Suraj Kapa, Paul A Friedman

Summary

Background Atrial fibrillation is frequently asymptomatic and thus underdetected but is associated with stroke, heart failure, and death. Existing screening methods require prolonged monitoring and are limited by cost and low yield. We aimed to develop a rapid, inexpensive, point-of-care means of identifying patients with atrial fibrillation using machine learning.

Lancet 2019; 394: 861–67 Published Online August 1, 2019 http://dx.doi.org/10.1016/S0140-6736(19)31721-0

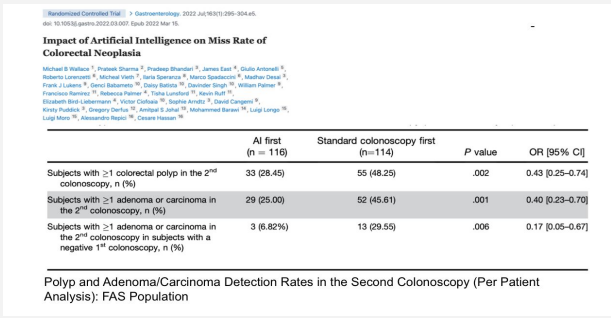
Can be done with BNP

No need to memorise anything here

2) Computational Pathology

Patterns in images

- Highlight regions of interest in a slide
- Detect presence of cancer
- Tumor grading
- Identify similar cases
- Predict mutation status



Impact of Artificial Intelligence on Miss Rate of Colorectal Neoplasia

	AI first (n = 116)	Standard colonoscopy first (n=114)	*P* value	OR [95% CI]
Subjects with ≥1 colorectal polyp in the 2nd colonoscopy, n (%)	33 (28.45)	55 (48.25)	.002	0.43 [0.25–0.74]
Subjects with ≥1 adenoma or carcinoma in the 2nd colonoscopy, n (%)	29 (25.00)	52 (45.61)	.001	0.40 [0.23–0.70]
Subjects with ≥1 adenoma or carcinoma in the 2nd colonoscopy in subjects with a negative 1st colonoscopy, n (%)	3 (6.82%)	13 (29.55)	.006	0.17 [0.05–0.67]

Polyp and Adenoma/Carcinoma Detection Rates in the Second Colonoscopy (Per Patient Analysis): FAS Population

No need to memorise anything here

3) Paper medical records

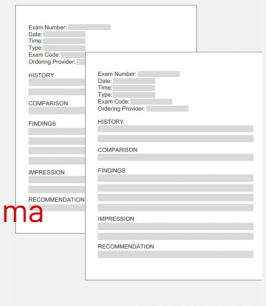
Patterns in text in clinical documentation and EHR

- Identify text scanned images
- Find specific medical information
- Reduce the amount of time to review so that instead of the physician opening one record of one patient at the time, AI can look at records of multiple patients and detect patterns.
  - Piloted across 7 practice areas
  - 10 to 29 percent time saving
- EHR has a lot of unstructured data (text), AI is being developed to be able to find specific medical information within the text.

4) Clinical narratives AI can detect & extract info to reach diagnosis (from structured & unstructured)

Pattern in text

- Radiology reports, clinical history, physical exam findings, operative report (unstructured data).
- Detect keyword and concepts
- Extract information
- Appendicitis, pneumonia, potentially malignant lesions, skeletal site specific fractures, asthma status, allergy status
  - Natural language processing (NLP)

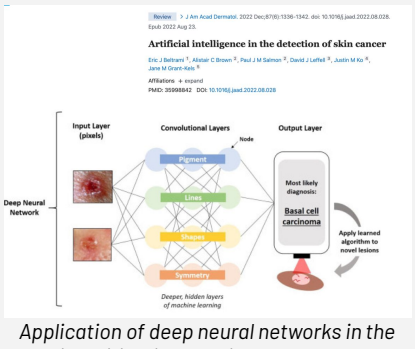


Exam Number:
Date:
Time:
Type:
Exam Code:
Ordering Provider:
HISTORY
COMPARISON
FINDINGS
IMPRESSION
RECOMMENDATION

5) Dermatology AI can look at pictures and provide diagnosis

↓نقاط لفهم وتوضيح الفكرة، لا تحفظون

- Teledermatology using AI offers dermatological expertise.
- Non Dermatologist clinicians increase confidence and improve appropriateness of referrals to dermatologists.
- AI can reduce unnecessary referrals and enhance the detection of medically concerning ones, potentially expediting access to dermatologists.
- Dermatologists have a crucial role in ensuring that it is patient- centered, clinician-led, high-quality, equitable, and accessible



Application of deep neural networks in the identification of skin neoplasms.

No need to memorise anything here

SHARED ACCOUNTABILITY

Very IMP

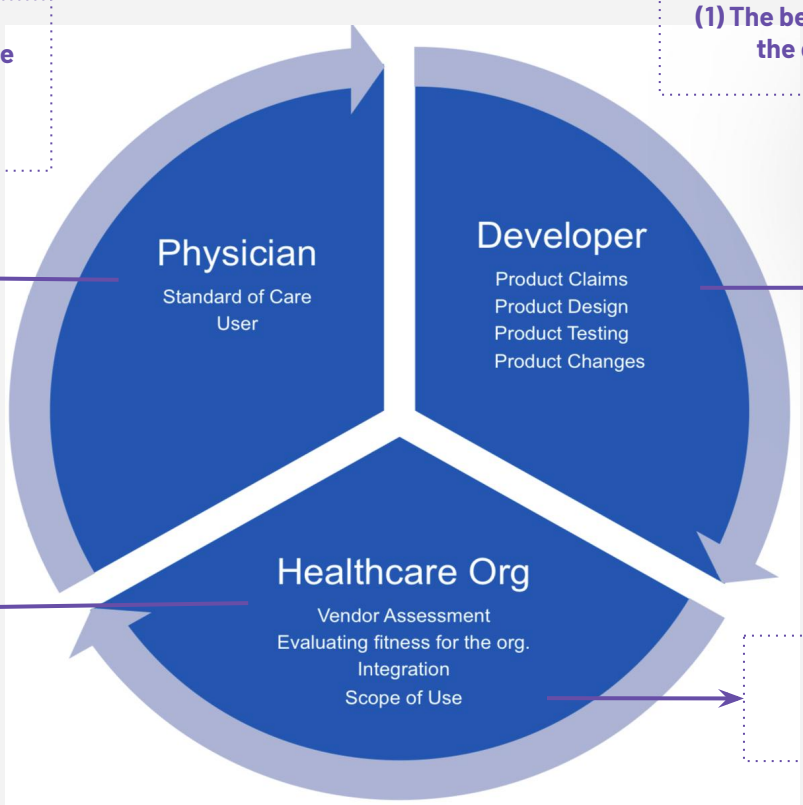
هذا أهم شيء نعرفه:
The cycle goes on, and this is a constantly shared accountability between the physician, (who use the system), the developers (who develop it), and the healthcare organizations (that deploy and implement it within their hospitals for the physicians to use it)

- Examples:

(1) The beginning is with the developer

(3) Now the main user is the physician, so to provide standard of care

The physician is now the user of the program



These are the things that the developers responsible for; also, the developers will sell the program for healthcare organizations

(2) Once the healthcare organization has bought the program, it's now the responsibility of the physician to use it

Healthcare organization responsibilities

BUILDING A HEALTHCARE AI FRAMEWORK

المطلوب معرفة الخطوات الخمس فقط. مع الفهم أيضًا.

- HUB AND SPOKE MODEL

- تطبيق على الخطوات:

مثال توضيحي لو عندي بحث، الخطوات المتوقعة هي:

1. IRB (Research and regulation).
2. Survey (Development and proposal).
3. Patient's consent (Risk management).
4. Randomized testing on group of participants (Testing).
5. Deploy and maintain survey (Deployment).

ANALYZE ETHICAL AND REGULATORY ASPECTS

VULNERABLE POPULATIONS

الدكتورة ما علقت على الجدول سوت له skip، بس اعرفوا التالي:

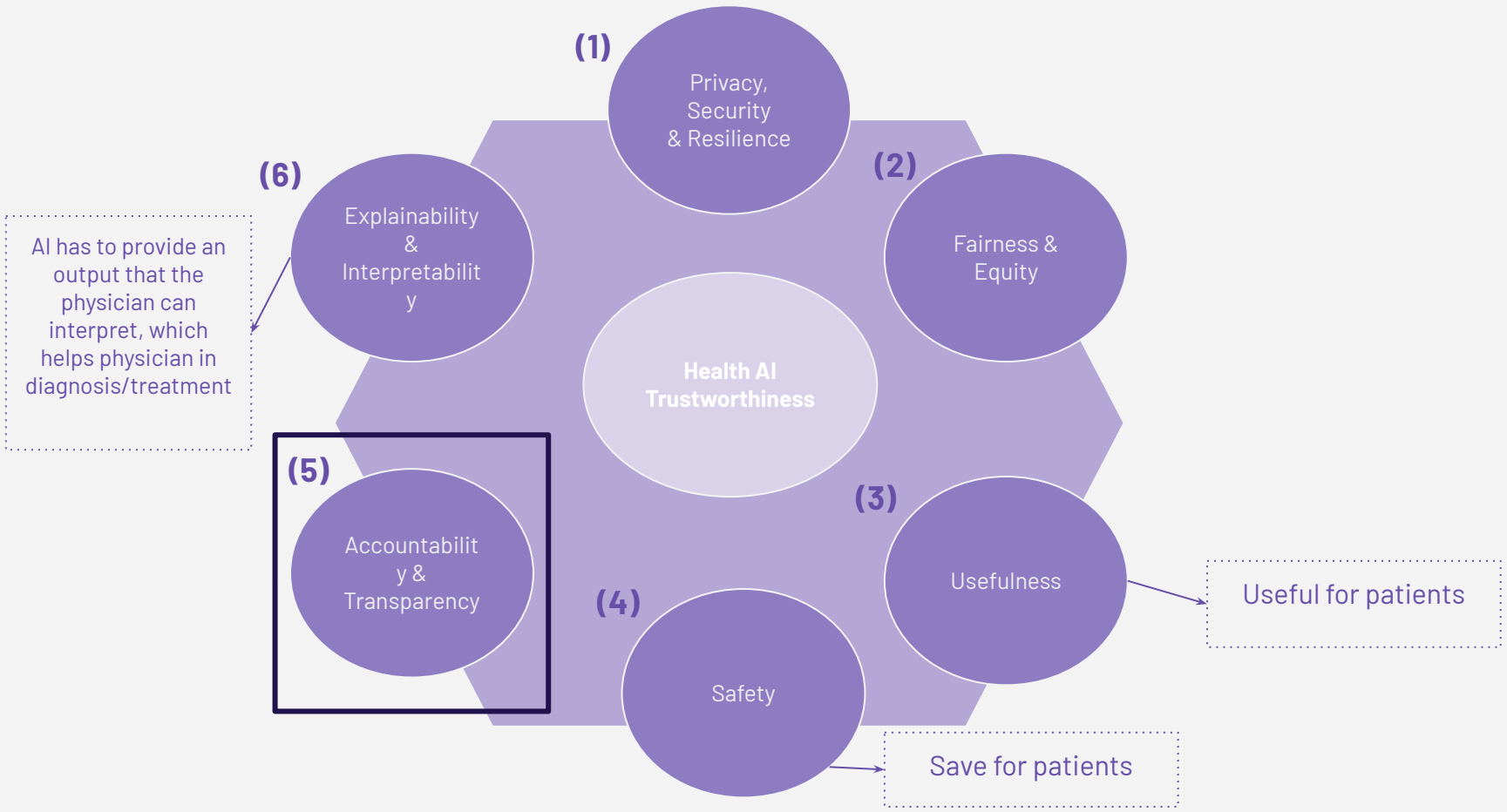
When designing AI tools, vulnerable populations of specific age groups or others (e.g., pediatric patients, patients with mental illnesses, or/& old patients) have to put into perspective or considered.

AGE	- Include the patient's chronological age at the time of study enrollment - When applicable and available, include the patient's developmental age. If unavailable, state as such - Attempt to include developmental stages and relevant milestone metrics of CYP e.g., height and weight percentile upon enrollment, to capture the heterogeneity of participants. If developmental metrics are unavailable, state them as such - Include the age(s) of intended algorithm users e.g., pediatric only, pediatric and adult, or adult only
COMMUNICATION	- Communication of study purpose to CYP as key stakeholders with developmentally appropriate communication strategies - Communication with parent(s) or legal guardians as key stakeholders - Tailor communication to social circumstance, addressing family complexities, including any court involvement - Clear communication of technology-specific study purpose, risks, benefits, and alternatives with all key stakeholders - Consider the use of videos, written material, and decision aids to facilitate education and enhance communication - Involve stakeholders, including CYP and parents, in focus groups for design feedback where possible and relevant legal and institutional permissions are obtained - State efforts taken to involve potential users in feedback of research idea and invest in community-level digital literacy - Where possible, document and articulate model explainability
CONSENT AND ASSENT	- Record mode of consent, who provided consent, e.g., parent, legal guardian, and how it was obtained - Document any complex parental relations, dynamics, or court involvement that impact consent - Document children's social circumstances as relevant to safety, participation and evaluation - For children in state-custody, ensure consent is obtained by relevant legal guardians or custodians and documented accurately - Document relevant child protection laws pertinent to individual cases - Attain assent when developmentally appropriate and/or required by regulations - Ensure minors participate in the assent process in accordance with their developmental skills (e.g., appropriate modifications for children with clinically relevant developmental delay) - Record age when assent is provided - Ensure local laws for adolescent assent/consent are followed
EQUITY	- Ensure inclusion and exclusion criteria are clearly defined and specify disease, symptom, or condition of interest, with developmental stages considered as appropriate - State processes employed to reduce selection bias - Transparent demographic reporting, including race, documented sex, gender, and socioeconomic factors 9 - Provide details on how gender and documented sex have been incorporated into the study design 7 - Incorporate accessible research design to facilitate the inclusion of patients with disabilities (developmental and otherwise) - If skin tone could influence algorithmic outputs, ensure it is documented - Indicate the source of demographic information (e.g., self-reported) as well as details on non-reporting and missingness - Discuss the role of community engagement in the study
PROTECTION OF DATA	-State how data collection aligns with study objectives -State data-sharing plans when relevant -State if data is identifiable or de-identified -If data is de-identified, state compliance with the relevant legal frameworks, e.g., HIPAA, Common Rule, GDPR 24,25 -State data protection plans, addressing unique data risks in AI/ML including protections against cybersecurity breaches. -Disclose whether data can or cannot be retrieved/removed in the future by parents and CYP -Ensure social context of child e.g., suspected or confirmed child abuse or complex social circumstance is accounted for prior to any data releases that may involve parental requests or involvement, if available
TECHNOLOGICAL CONSIDERATIONS - (TRANSPARENCY OF TECHNIQUES TRAINING, AND TESTING METHODOLOGY)	- Ensure algorithmic studies are tailored to the needs of the pediatric population and clearly documented in the study protocol - Ensure AI/ML techniques are only used when potentially beneficial to the pediatric population, and that such benefits are clearly detailed in the study protocol - Detail any potential harms that pediatric subjects may incur as a result of the study - Identify measures taken to minimize risk to pediatric subjects throughout study and post-implementation - State measures taken to monitor and document adverse events that may affect pediatric subjects - State outcome measures and plans to clinically evaluate performance of algorithms on pediatric subjects - When available, utilize validated pediatric clinical scales in the clinical algorithm evaluation - Articulate how AI/ML will be trained to recognize/account for developmental heterogeneity - Document AI/ML methods using validated guidelines, e.g CONSORT-AI and SPIRIT-AI10,11 - Define data input and output (e.g., images, text) as well as the source (e.g., public dataset), and output - Account for age-specific factors related to disability and developmental conditions (e.g., natural disease progression) as relevant in study design, testing, and evaluation - State if the study involves adult, pediatric, or mixed data in training and/or testing - If the study involves both adult and pediatric data, state the purpose for this combination - If the study involves both adult and pediatric data, state whether the same or separate algorithms were used to assess each group

ACCEPT-AI Framework: Key recommendations for pediatric data use in AI/ML research.

CORE CHAI/NIST ALIGNED PRINCIPLES

Developing health AI trustworthiness focuses on these elements 1,2,3,4,5,& 6



ANTICIPATE FUTURE AI TRENDS IN HEALTHCARE

Future opportunities for AI in healthcare (3 main elements 1,2,& 3)

1. Adaptive AI:

Moving from semi-structured learning to a more adaptive and generative AI → requires feedback and less supervision from developers.

2. Generative AI (Real faced learning)
3. Diverse use cases:

أغلب ال cases الموجودة الأن على الـ AI تخص populations معينة، لذلك لازم نزيد ال cases ونخليها more diverse، وتشمل : أفريقيا و الشرق الأوسط، ولا غيرها، وكل ما زادت ال data (البيانات)، ومل ما قلت ال rare cases اللي ال AI ما يقدر يسوي له population ، لأنه ماعنده معطيات كافة لها.

MCQs

1. Which of the following is a subset of AI that uses layered artificial neural networks?

A) Deep Learning
B) Machine Learning
C) Reinforcement Learning
D Supervised Learning

2. Which of the following is a subset of AI that uses statistical algorithms to represent complex patterns within data?

A) Machine Learning
B) Reinforcement Learning
C) Causal Inference
D) Self-Supervised Learning

3. How can AI enhance patient monitoring systems in nursing care?

A) By reducing nurse workload and increasing routine tasks
B) By automating all patient care tasks
C) By replacing nurses with AI systems
D) By tracking patient data and detecting abnormalities, leading to timely alerts

4. What is the term for learning from a small amount of labeled data combined with a large amount of unlabeled data?

A) Supervised Learning
B) Unsupervised Learning
C) Semi-Supervised Learning
D) Reinforcement Learning

5. Which framework is recommended for ensuring fair AI practices in pediatric data use for AI/ML research?

A) AI FAIRNESS
B) ACCEPT-AI Framework
C) Standardize safe AI practices
D) Regulatory strategy

6. Which medical area involves identifying text in scanned images and reducing review time?

A) Cardiology
B) Dermatology
C) Computational Pathology
D) Clinical Narratives

Answers key

1- A 2- A 3- D 4- C 5- B 6- D

Members Board

Informatics 442

Team leaders

Ghada Bin Slmah

Rand AlJarallah

Meshari Alshathri

Team members

Raneem Alwatban

Mohammed alzeer

Nawaf Alrefaei

Layan Aldoukhi

Sara Almajed

Amani Alotaibi

Fatima Halawi

Fay aldossari

Razan Almohanna

Nouf Aldhalaan

deema aljuribah

Hazem almalki

Maram Beyari

Abdulaziz Saad Alqahtani

Raid almadi

Special thanks to Razan and Nouf