

Talk/Debate -

AI use in ART: Is it Artificial or Intelligent?

Ilan Tur-Kaspa, MD, Ravi Gada, MD,  
Charlie Bormann, PhD, HCLD,

# Disclosures

- Ravi Gada
  - **Owner/Co-Owner Founder/Co-Founder:** ReUnite Rx
- Ilan Tur-Kaspa
  - **Consulting Fee (e.g., Advisory Board):** Ferring Pharmaceutical
  - **Stock Option Holder (Individual stocks/Stock options; diversified mutual funds do not need to be disclosed):** Embryonics Ltd, Israel
- Charlie Bormann
  - Nothing to Disclose



# Learning Objectives

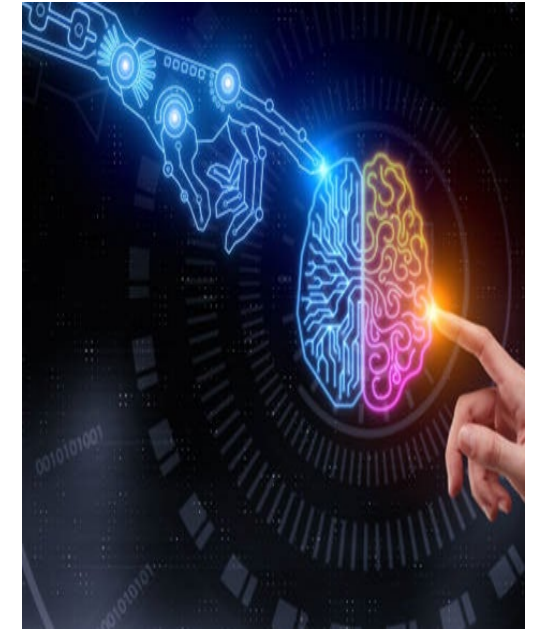
- 1) Demonstrate knowledge of AI potential use in Reproductive Medicine.
- 2) Use AI assisted decision making tools.
- 3) Integrate AI tools in clinic and IVF Lab specific practices to improve ART outcome.

# Repro-AI to optimize ART outcome

Repro-AI is defined as the interdisciplinary technology between reproductive medicine and mathematical sciences to advance the applications of AI in the diagnosis and treatment of infertility.

## Debate - AI Use in ART: Is It Artificial or Intelligent? Pros and Cons

Ilan Tur-Kaspa, MD, Ravi Gada, MD,  
Charlie Bormann, PhD, HCLD,



**Should humans  
improve their  
intelligence  
instead of AI ?**

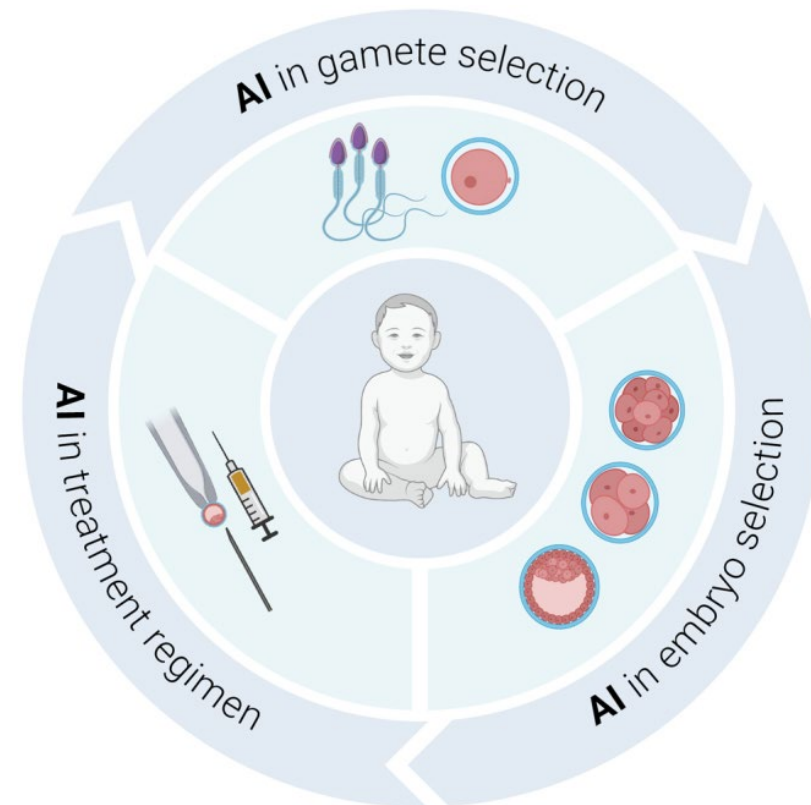
# Repro-AI to optimize ART outcome

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**PCRS 2024**

# AI to optimize IVF outcome

## Disclosures – no financial conflict of interests

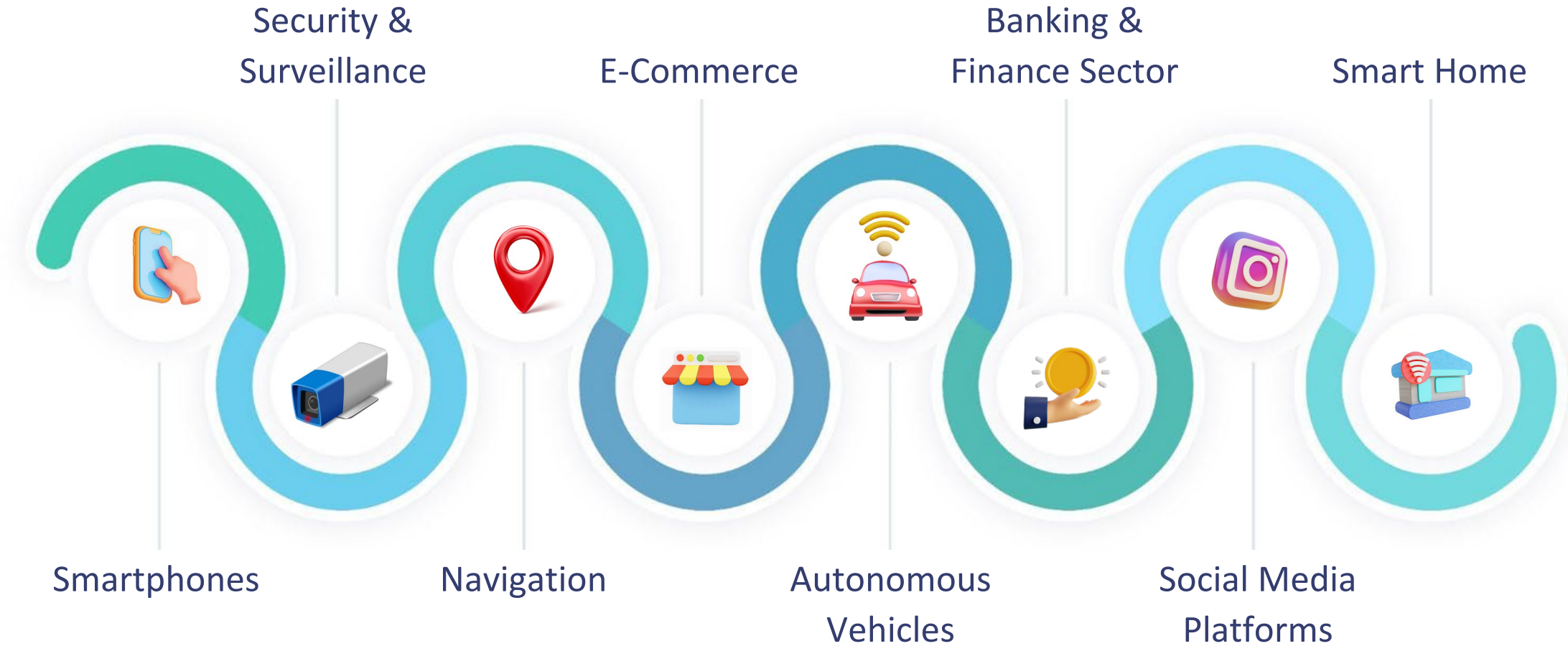
- Past Head, Medical Advisory Board, 2/2021-9/2023, for Embryonics, Ltd, an AI startup developing and applying AI data-driven solutions to improve IVF outcome.
- Pinnacle fertility, USA - PI, Pinnacle AI Study Group
- Ferring – Advisory Boards, 2022-2023



## **Needs Assessment and Expected Learning Outcomes**

1. The participant should be able to describe AI potential use in Reproductive Medicine.
2. The participant should be able to experiment the management of ART patients with AI assisted decision making tools.
3. The participant should be able to objectively select AI tools for clinical and Lab setup to improve ART outcome.

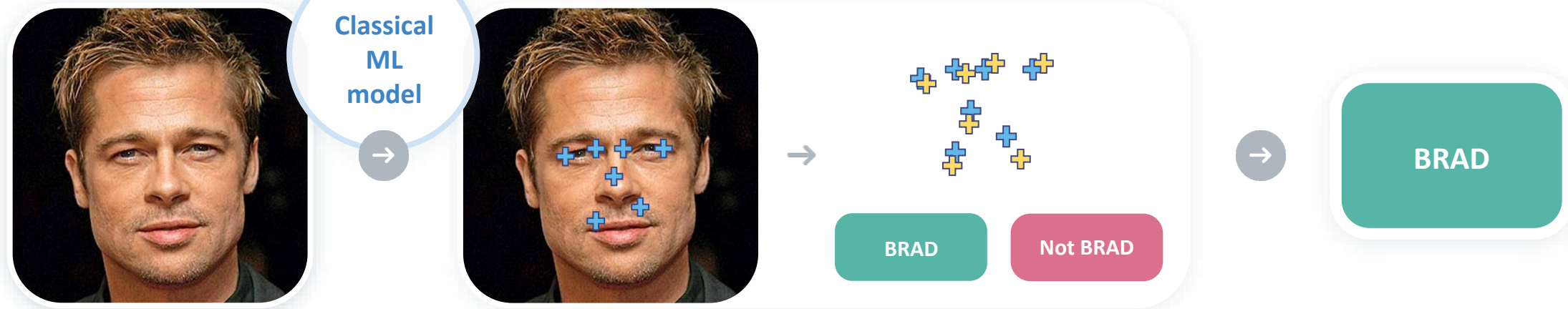
# Artificial Intelligent (AI) is everywhere



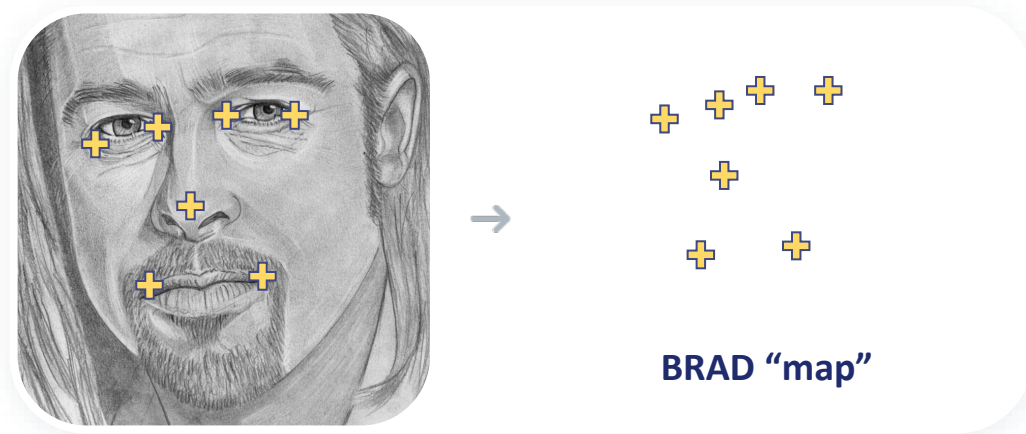


# “Classical” AI Machine Learning

BRAD or Not BRAD?



A Human defines how to identify a BRAD



Model “training”-

**Feature Engineering:**

An Expert defines what are the important features and a BRAD “map” is extracted from previous examples.

**<70% accuracy**

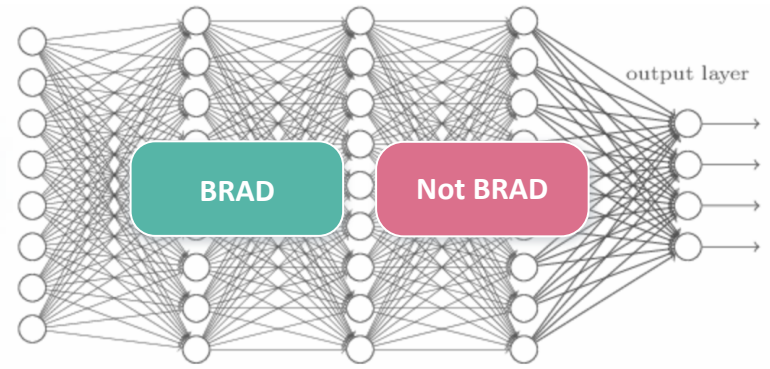
# AI Deep learning - How is it different than classical models?

*Hint: no feature engineering*

## BRAD or Not BRAD?



Deep learning model



BRAD



BRAD

Not BRAD

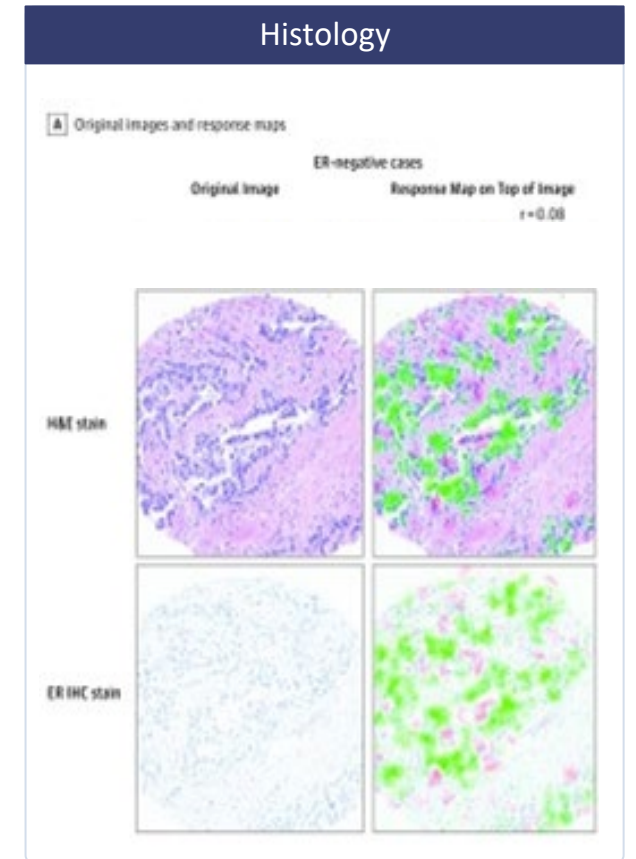
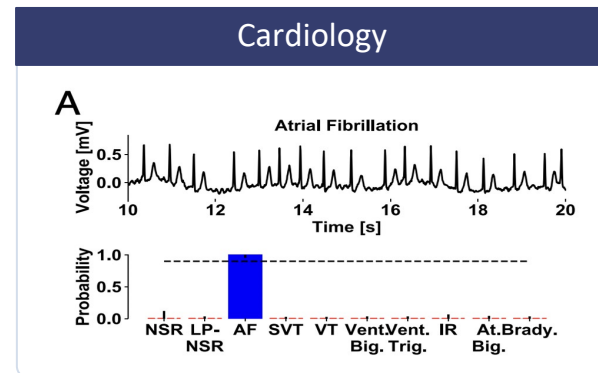
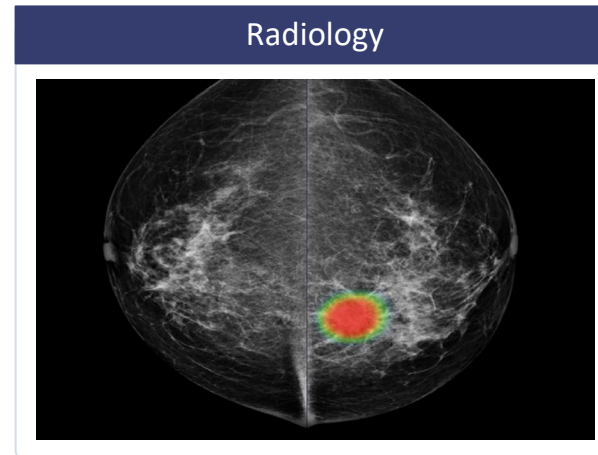
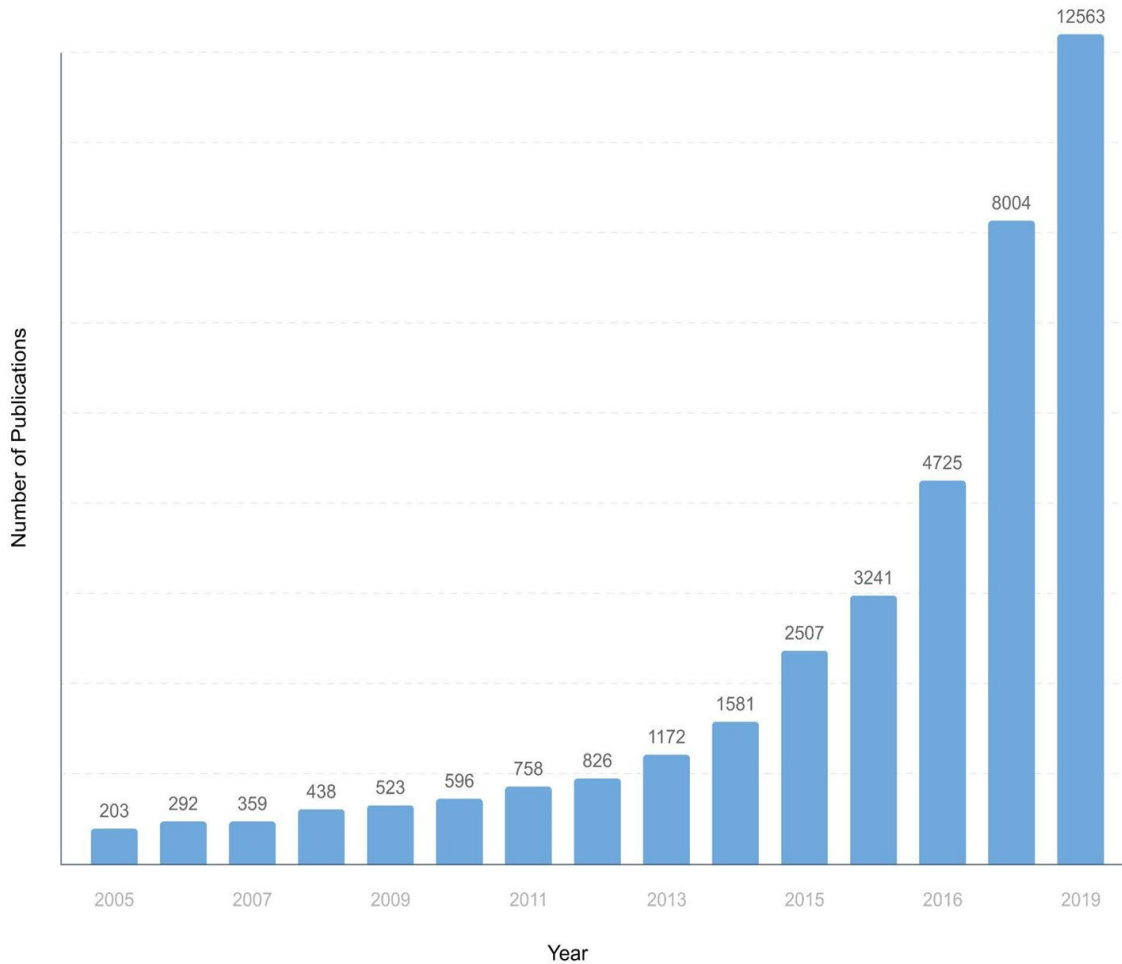


**Model "training"** -  
The model "sees" samples of BRAD and Not BRAD and **learns its own important feature** for identification

**>99.9% accuracy**



# Published medical AI studies grew by 2,400% in last decade



Meskó, B., Görög, M, npj Digit. Med 2022. Attia Z. et al., The Lancet, 2019. Elul Y. et al., PNAS, 2021. Shamai G. et al, JAMA Network 2021. Choi S. Y. et. al. Medicine (Baltimore), 2021

**Daniel Kahneman.**

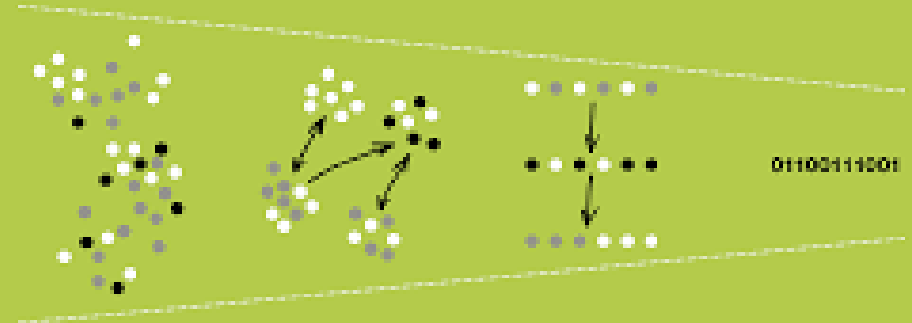
**Nobel Prize in Economics in 2002**

How human judgment may take heuristic shortcuts that systematically depart from basic principles of probability



The Knowledge Funnel

Mystery → Heuristic → Algorithm → Code



“Whenever there is judgment, there is noise”

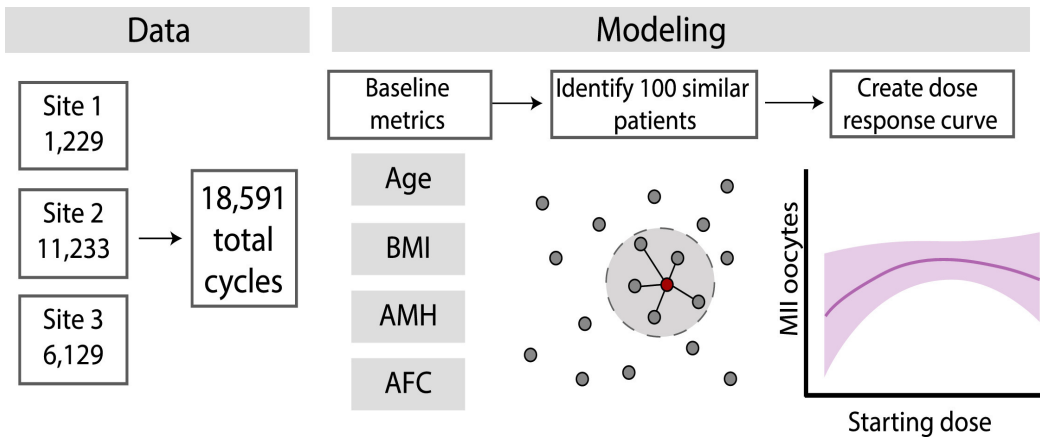
# Why AI in ART?

- Simultaneous objective, accurate, and rapid assessment of relevant variables
- Precision, standardization, and automation
- Minimal training needed
- May provide guidance in clinical decisions
- AI for image analysis: embryos, sperm, oocytes, and ultrasound pictures.
- **Key for success: combining knowledge of Fertility Experts with AI scientists [Repro-AI]**

Clinical	Lab
Diagnosis	Sperm - diagnosis and treatment
Treatment plan – protocol, dosage	Oocyte – prognosis
Cycle monitoring, trigger, ai ER test	Embryo – selection, aiPGT, prediction

# AI to assist in individualized FSH starting dose for IVF

## AI for the optimal day of trigger during COS for IVF



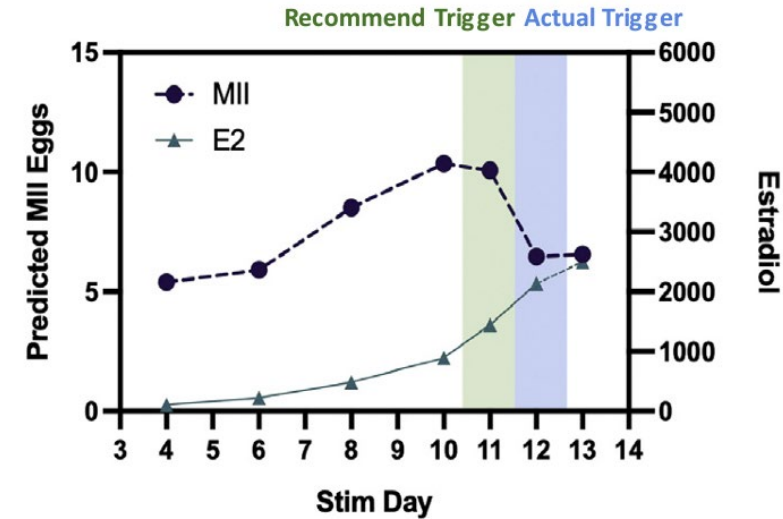
2014-2020

Dose response curve generated for each participant using 100 nearest neighbors matched by age, BMI, AMH and AFC.

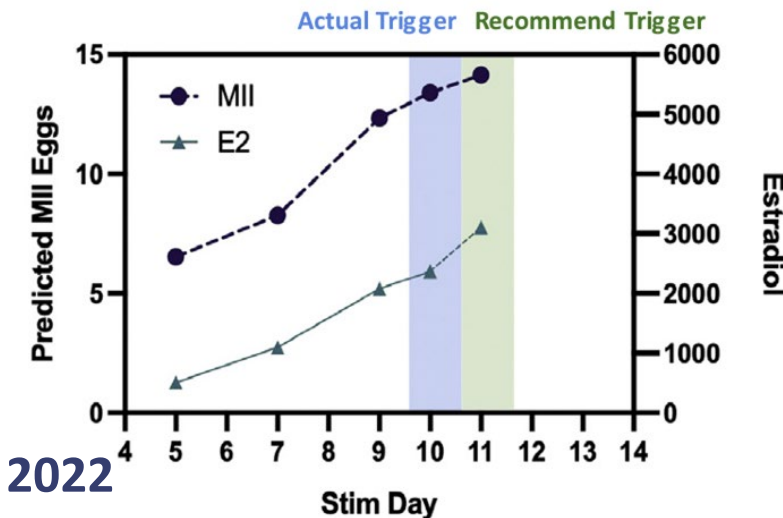
**Dose-responsive group (1/3):** With optimal FSH starting dose, patients had 1.5 more MII oocytes, and 0.6 more usable blastocysts.

- Retrospective multicenter of 30,278 IVF cycles (2014-2020).
- Patients with early or late triggers compared with matched patients with on-time triggers, had on average 2.5 fewer MII oocytes and 0.9 fewer usable blastocysts

Example of Possible Late Trigger



Example of Possible Early Trigger



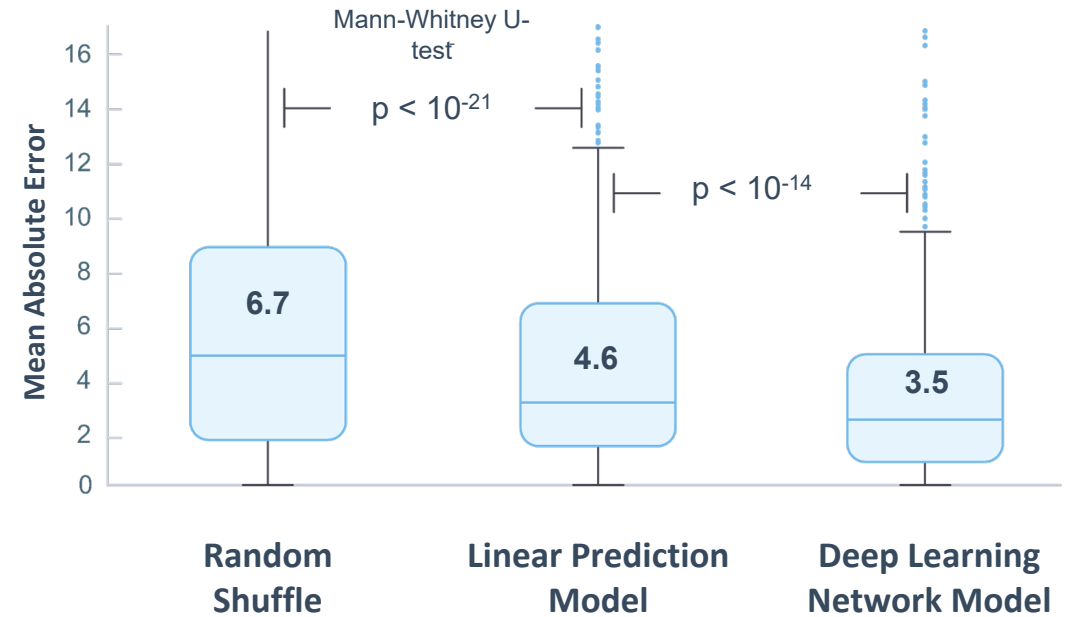
# ALIFE Stim Assist

# Cycle Clarity

# AI, Deep neural network with Geometric Layers, to Optimize Ovarian Stimulation for IVF: From Stimulation Protocols to Mature Oocyte Yield

- **Study Question:** Can AI, using patient demographics, routine preliminary blood tests and AFC assist in choosing the optimal controlled ovarian stimulation (COS) to maximize mature oocyte yield and enhance IVF success?
- Used IHR.
- Mean average error (MAE) for the AI was 3.5, far superior to classical models

## Mean Absolute Error for AI Model Compared to Random



Mean Absolute Error (MAE), representing average expected deviation from the true value of three models: a random model where actual mature oocyte yields from the data set were randomly ascribed to a patient; a linear prediction model; and the deep learning network model, which was significantly more accurate.

**Tur-Kaspa et al, ESHRE, July 2022**

# Personalized Fertility Calculator (PFC)

- Fertility preservation is on the rise.
- Young healthy women are turning to online resources to educate themselves and planning for the future.
- Better prediction means better planning.
- **Data driven literature integration is a way to gap between outcomes of infertility treatments and fertility preservation cycles.**

Aviram T, Silver DH, Rosentraub S, Fordham D, **Tur-Kaspa I.**  
An AI based Personalized Fertility Calculator (PFC) to Assist Decision-making Before Oocyte Cryopreservation. ISFP 2022

“I would’ve given anything if someone had said to me, ‘Freeze your eggs. Do yourself a favor.’”

**allure**

November 2022

SIGN IN



GIFT GUIDES

AWARDS

NEWS

SKIN

MAKEUP

HAIR



## Jennifer Aniston Has Nothing to Hide

JENNIFER ANISTON HAS SPENT MOST OF HER ADULT LIFE IN THE SPOTLIGHT, WITH ALL ITS GLARE. AT 53, SHE OPENS UP ABOUT HER PATH TO LEAVING REGRETS AND SOME DEEPLY PERSONAL PAIN BEHIND.

BY: DANIELLE PERGAMENT  
PHOTOGRAPHED BY: ZOEY GROSSMAN



# Personalized Fertility Calculator (PFC)

- Evidence based patient education resources
- Oocyte yield per cycle
- Probability of live birth per number of mature cryopreserved oocytes.



Aviram T, Silver DH, Rosentraub S, Fordham D,  
**Tur-Kaspa I.** An AI based Personalized Fertility  
Calculator (PFC) to Assist Decision-making Before  
Oocyte Cryopreservation. ISFP 2022.



# Ultrasound and Endometrial Receptivity

## AI and Endometrial Receptivity = aiER

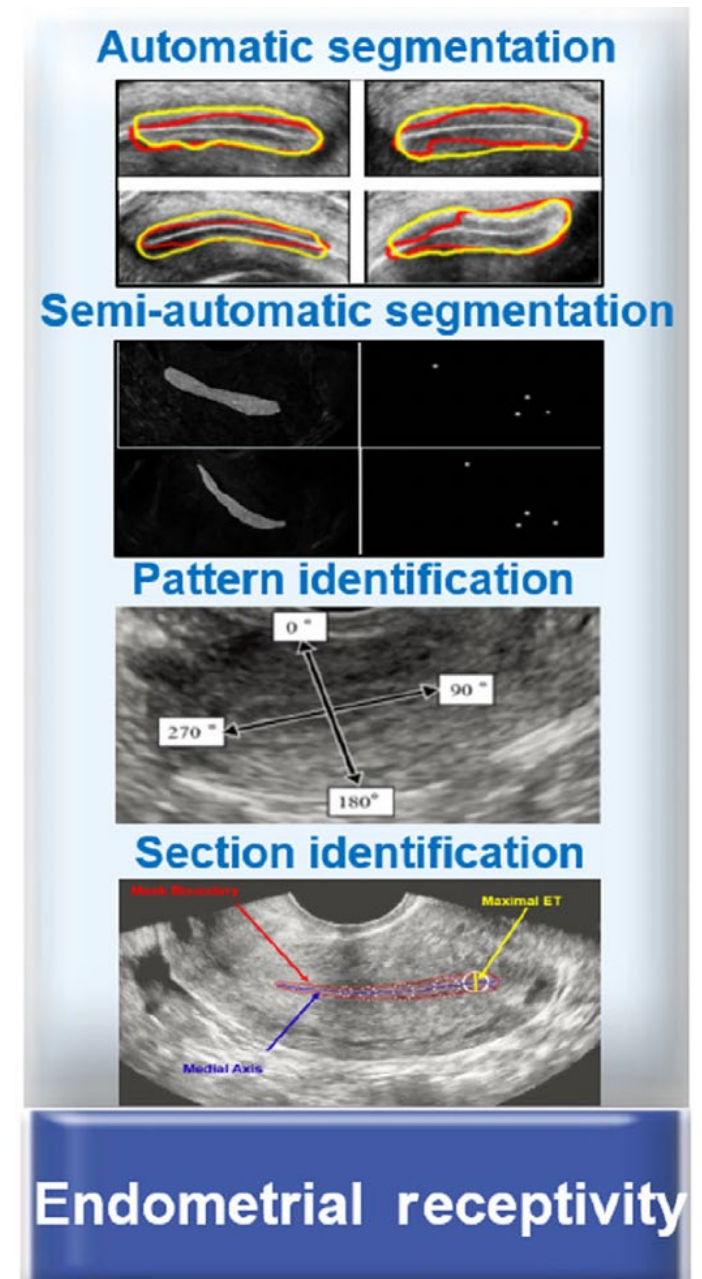
Tur-Kaspa et al, in preparation

**Objective: To compare AI interpretation of US images with ER test results and with ET/FET outcomes**

- The ability of Ultrasound to determine Endometrial Receptivity is poor.

(Human Repro Update 2019)

- There is a drive to incorporate AI techniques used in other areas of radiology to improve the efficacy of US in this area.





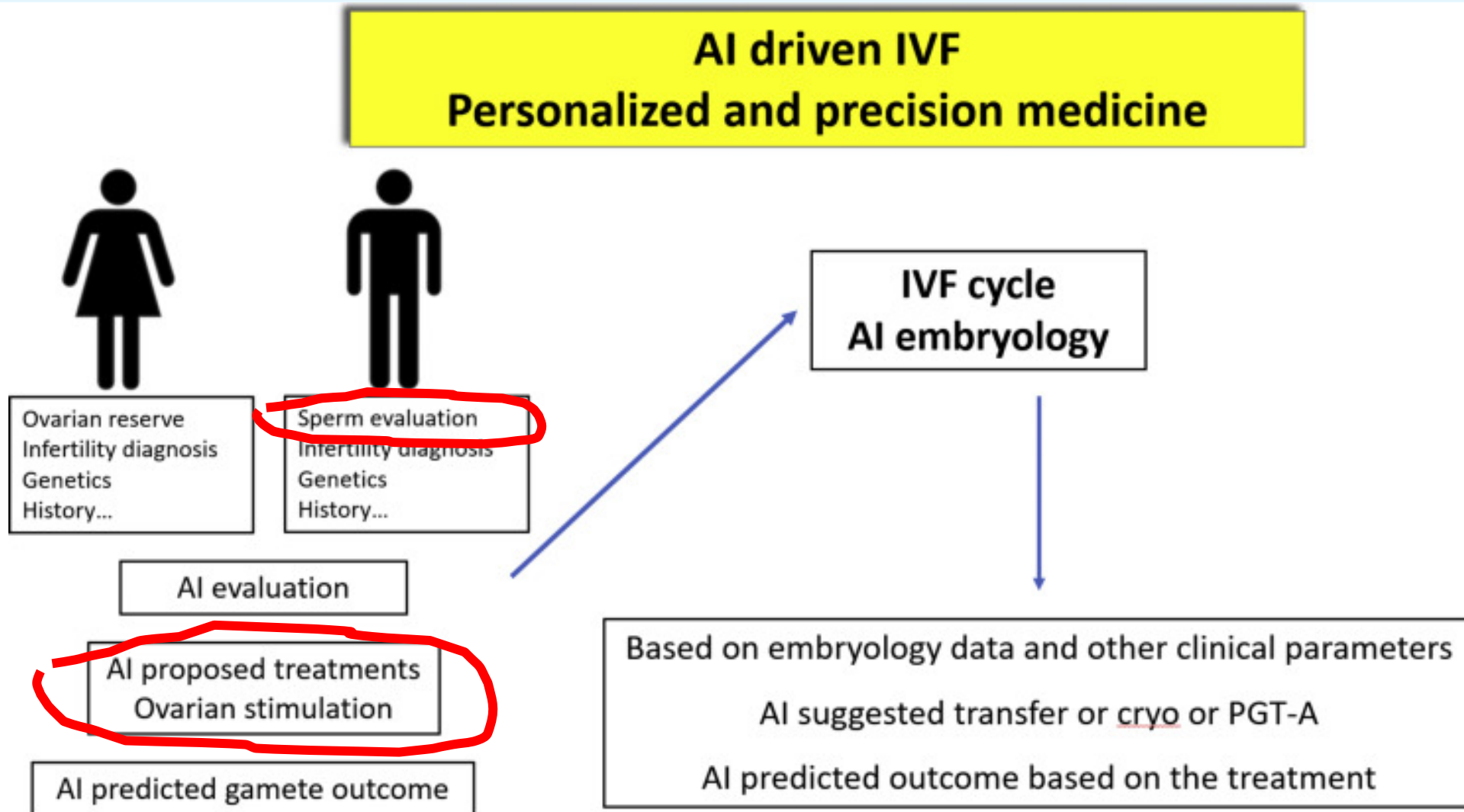
## Ethical & Patients' privacy considerations

# AI in IVF - an assistive technology



- AI to assist or taking control in the decision making:  
what if the AI and the clinician disagree?
- Liability: no change
  1. when medical/lab decision is based on an AI product
  2. when AI is NOT used to assist in medical/lab decision
- HIPAA and data privacy of large datasets -  
Secure large data-sharing by blockchain ?

# The Future of IVF



**Please show me that your AI  
is better than my HI ..!**



**Pinnacle AI Study Group**

**@ IHR**

**Thank  
you**



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