

# Artificial Intelligence and Aging

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# Who am I ?

- Medical doctor specialized in Psychiatry
- Scientist in Bayesian Artificial Intelligence and Networks to understand mental disorders
- Translate fundamental AI principles to modern healthcare challenges and policy
- Lecturer on Medical Informatics at ULBruxelles
- Lecturer on Physiology at École Supérieure de la Santé in Lausanne, Switzerland

# From AI to Augmented Medicine

- AI has revolutionized medicine by offering
  - An increased autonomy for patients
  - Advanced tools for clinicians
- A new & exciting field of medicine is arising:  
Augmented Medicine
  - Framework of techniques for clinical practice
  - Innovative methods for research & development

# A brief history of AI in medicine

- Early 2000s
  - Machine learning
  - Neural networks for risk detection
- 2010-today
  - Community detection & clusters
  - Deep learning
  - Hybrid tools

# AI and Aging

- Most of medical technologies were developed to target seniors
- The aging individual:
  - Is isolated
  - Is polychronic
  - Is well-known in hospitals (EHR are full of records)

# How can AI help the aging individual?

- Monitoring
- Prediction
- Diagnosis (Causal Inference)
- Personalized medicine

# Promises of medical AI - Monitoring

- Monitoring is a heavy but simple task that has a high added clinical value
- AI tools and devices create a framework for the continuous medical monitoring
- Monitoring was the initial goal of medical technology
- The goal is to separate what is normal from abnormal and alert the doctor / close ones
  - Heart Rhythm: Arrhythmias
  - Diabetes: Hypo/hyperglycemic episodes
  - Epilepsy: seizure detection

# Challenges of medical AI - Monitoring

- Although initially interested in monitoring, medical devices shifted towards the quantified self
  - Reaches a wider population (everyone)
  - Many different data types are collected
  - Important selection bias: younger people
- Monitoring wearables have been adopted by entire countries to drive lifestyle changes in their population
  - Such lifestyle changes could be centered onto biased vision of “healthy lifestyle” (because of biased data)



# Promises of medical AI - Prediction

- Information from Electronic Health Records (EHR) can be retrieved to predict whether a patient is at risk of a given medical condition
  - Cardiovascular risk
  - Renal failure
  - Digestive disorders
- Combined with Natural Language Processing of EHR in hospitals, prediction could constitute a live dashboard of what the patient might risk
  - Clinical decision support systems

# Promises of medical AI - Diagnosis

- Diagnostic AI ranges in a variety of fields and is deeply rooted in Bayesian AI (causal inference)
  - Body Parameters from monitoring (machine learning)
  - Medical imaging (deep learning)
  - Video inputs e.g. endoscopy (deep learning)
  - Histopathology slides (networks)
  - Outsourced medical history taking / expert system (networks)
- Two medical specialties are being revolutionized : diagnostic radiology and histopathology

# Challenges in medical AI – Prediction & Diagnosis

- First: The replicability crisis (to solve with open science)
  - Most AI studies fail to replicate in other populations
  - Most AI studies are reported to have unreliable design
  - Most tools therefore lack a clinical validation
- Second: The overfitting (to solve with audit and recalibration)
  - Most algorithms perform very well in source population (training and testing data sets) but poorly in other populations
  - Big issue because it is detected after the algorithm is adopted

# Challenges in medical AI – Prediction & Diagnosis

- Third: study of AI against doctors
  - Industry is pushed towards such studies to prove performance
  - However, doctors will be kept for more than to be a safety net around AI
  - In fact, AI does not change what it means to be a doctor, but changes what a doctor will do
  - In the next decade, we need studies that report the performances of AI & doctors to see how it makes a difference

# Promises in medical AI – Personalized medicine

- AI performs great when dealing with specific kinds of data
  - High dimensional data (genetics)
  - Temporal data (imaging, endoscopy)
- Such powerful analysis tools allow for personalizing medicine and empowering patients
  - Health environments within smartphone
  - Personal EHR

The challenge are always the same: data protection and accuracy of inference

# AI: accelerate drug discovery and trials

- Standard drug discovery : 3 B \$
- Testing a number of candidates
- AI: generate and analyse data to highlight differences
  - Identify best candidates
- In Silico trials
  - Computer simulation of human pathophysiology
  - Reduce size and duration
  - No adverse effects in real patients

# Further challenges for medical AI

- Overcoming the abyss between industry and healthcare institution
  - Building trust by improving design
  - Co-develop solutions from the start
  - The doctor-engineer partnership
- Getting our healthcare institution up-to-date considering new healthcare players
- Educate (future) doctors to AI
  - So that they will know how to use it
  - So that they will know how to (co-)develop it
  - So that they will know how to evaluate it

# Conclusion

AI as support, not enemy

Improve design to make it safe

Study doctor + AI to implement in clinical settings

Build bridges between industry and healthcare institutions

Educate doctors to AI



# Thank you!

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