# Ethical issues in Artificial Intelligence in Health care

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# What is Artificial Intelligence

- Definition--"Use of a computer to model intelligent behaviour with minimal human intervention"
- Machines & computer programs are capable of **problem solving and learning, like a human brain**.
- Natural Language Processing ("NLP") and translation,
  - Pattern recognition,
  - Visual perception and
  - Decision making.
- Machine Learning ("ML"), one of the most exciting areas for Development of computational approaches to **automatically make sense of data**
- Advantage of Machine
  - Can retain information
  - Becomes smarter over time
  - Machine is **not susceptible to** Sleep deprivation, distractions, information overload and short-term memory loss

# **Global Challenges**





A Growing Total World Population



13+ Million Provider Shortfall



An Aging Developed World Population



**Chronic** and **Preventable** Disease **Epidemic** 

# Growth drivers of AI in healthcare

- Increasing individual healthcare expenses
- Larger Geriatric population
- Imbalance between health workforce and patients
- Increasing Global Health care expenditure
- Continuous shortage of nursing and technician staff The number of vacancies for nurses will be 1.2 million by 2020
- AI is and will help medical practitioners efficiently achieve their tasks with minimal human intervention, a critical factor in meeting increasing patient demand.



# Innovations in Medical and Biological Engineering

- 1950s and earlier
  - Artificial Kidney
  - X ray
  - Electrocardiogram
  - Cardiac Pacemaker
  - Cardiopulmonary bypass
  - Antibiotic Production technology
  - Defibrillator
- 1970s
  - Computer assisted tomography
  - Artificial hip and knee replacements
  - Balloon catheter
  - Endoscopy
  - Biological plant food engineering

- 1960s
  - Heart valve replacement
  - Intraocular lens
  - Ultrasound
  - Vascular grafts
  - Blood analysis and processing
- 1980s
  - Magnetic resonance imaging
  - Laser surgery
  - Vascular grafts
  - Recombinant therapeutics
- Present day
  - Genomic sequencing and microarrays
  - Positron Emission tomography
  - Image guided surgery

New generations of medical technology products are Combination of different technologies which lead to the crossing of borders between traditional categories of medical products such as medical devices, pharmaceutical products or human tissues



#### **Converging technologies**

# Artificial intelligence in medicine : The virtual branch

The virtual component is represented by Machine Learning, (also called Deep Learning)-mathematical algorithms that improve learning through experience.

## Three types of machine learning algorithms:

- 1. Unsupervised (ability to find patterns)
- 2. Supervised (classification and prediction algorithms based on previous examples)
- 3. Reinforcement learning (use of sequences of rewards and punishments to form a strategy for operation in a specific problem space)











# **Benefits of Artificial intelligence**

- AI can definitely assist physicians
  - Clinical decision making better clinical decisions
  - Replace human judgement in certain functional areas of healthcare (eg, radiology).
  - up-to-date medical information from journals, textbooks and clinical practices
  - Experienced vs fresh Clinician
  - 24x7 availability of expert
- Early diagnosis
- Prediction of outcome of the disease as well as treatment
- Feedback on treatment
- Reinforce non pharmacological management
- Reduce diagnostic and therapeutic errors
- Increased patient safety and Huge cost savings associated with use of AI
- Al system extracts useful information from a large patient population
- Assist making real-time inferences for health risk alert and health outcome prediction
- Learning and self-correcting abilities to improve its accuracy based on feedback.



#### **Cancer Classification**

Epidermal Lesions

Melanocytic Lesions

Melanocytic Lesions (Dermoscopy)







Malignant



# Artificial intelligence in medicine: The physical branch

It includes:

- Physical objects,
- Medical devices
- Sophisticated robots for delivery of care (carebots)/ robots for surgery.



# Use of robots to deliver treatment - Robotic surgery



### Use of robots to monitor effectiveness







**AI Challenges** 

## Potential challenges

Industry Challenges<sup>11,12</sup>

High initial capital requirement

Potential for increased unemployment

Difficulty in deployment

Reluctance among medical practitioners to adopt Al

Ambiguous regulatory guidelines for medical software

Lack of curated healthcare data

Concerns regarding privacy and security

Lack of interoperability between AI solutions

State and Federal Regulations

• Development costs

- Integration issues
  - Ethical issues
  - Reluctance among medical practitioners to adopt AI
  - Fear of replacing humans
- Data Privacy and security
  - Mobile health applications and devices that use AI
  - Lack of interoperability between AI solutions
- Data exchange
  - Need for continuous training by data from clinical studies
  - Incentives for sharing data on the system for further development and improvement of the system. Nevertheless,
  - All the parties in the healthcare system, the physicians, the pharmaceutical companies and the patients, have greater incentives to compile and exchange information
- State and federal regulations
- Rapid and iterative process of software updates commonly used to improve existing products and services

#### Key takeaways

Artificial intelligence will...

- Enable preventive and precision medicine
- Improve patient experience, access and outcomes
- Augment the intelligence of the clinician, and remove non-value added work
- Create increasing opportunities for corporate clinical co-creation and innovation
- Answer global healthcare challenges
- Create the Perpetual Global Clinical Trial
- Allow us to "know" our patients like never before







### Recent initiatives on Ethics of AI

- •1.UK Govt Centre for data ethics and Innovation 2018
- •2.Ada Lovelace Institute of Nuffield Foundation
- 3. Patnership on AI between Amazon, Apple, DeepMind, Facebook, Google, Microsoft & IBM
- 4.IEEE Global initiative on ethics of Autonomous and Intelligent systems in 2016
- 5. Asilomar AI principles developed in 2017
- •6. House of Lords Select committee on Al
- •7.European group on ethics in Science & New technologies in 2018
- •WHO Consultative meeting on AI & health care 2019



Many ethical and social issues raised by Al overlap with those raised by data use; automation; the reliance on technologies more broadly; and issues that arise with the use of assistive technologies and 'telehealth'.

- RELIABILITY AND SAFETY
- TRANSPARENCY AND ACCOUNTABILITY
- DATA BIAS, FAIRNESS, AND EQUITY \_\_\_\_
- EFFECTS ON PATIENTS
- TRUST
- EFFECTS ON HEALTHCARE PROFESSIONALS
- DATA PRIVACY AND SECURITY
- MALICIOUS USE OF AI
- CHALLENGES FOR GOVERNANCE

Guidelines for Trustworthy AI issued by



#### European Commission, 2018

#### <u>Ethical principles in AI</u>

- Develop, deploy and use AI systems in a way that adheres to the ethical principles of: respect for human autonomy, prevention of harm, fairness and explicability. Acknowledge and address the potential tensions between these principles.
- Y Pay particular attention to situations involving more vulnerable groups such as children, persons with disabilities and others that have historically been disadvantaged or are at risk of exclusion, and to situations which are characterised by asymmetries of power or information, such as between employers and workers, or between businesses and consumers.
- Acknowledge that, while bringing substantial benefits to individuals and society, Al systems also pose certain risks and may have a negative impact, including impacts which may be difficult to anticipate, identify or measure (e.g. on democracy, the rule of law and distributive justice, or on the human mind itself.) Adopt adequate measures to mitigate these risks when appropriate, and proportionately to the magnitude of the risk. Continuous RISK \_ BENEFIT Assessment

#### Seven requirements for Trustworthy Al



- Ensure that the development, deployment and use of AI systems meets the seven key requirements for Trustworthy AI: (1) human agency and oversight,
- (2) technical robustness and safety,
- (3) privacy and data governance,
- (4) transparency,
- (5) diversity, non-discrimination and fairness,
- (6) environmental and societal well-being and
- (7) accountability.

Consider technical and non-technical methods to ensure the implementation of those requirements.

### Ethical principles identified in existing AI Guidelines(Effy Vayena et al)(Nature machine Intelligence, 2019)

#### • Transparency - 73/84

Transparency, explainability, explicability, understandability, interpretability, communication, disclosure, showing

• Justice and fairness -68/84

Justice, fairness, consistency, inclusion, equality, equity, (non-) bias, (non-)discrimination, diversity, plurality, accessibility, reversibility, remedy, redress, challenge, access and distribution

• Non-maleficence - 60/84

Non-maleficence, security, safety, harm, protection, precaution, prevention, integrity (bodily or mental), non-subversion

• Responsibility - 60/84

Responsibility, accountability, liability, acting with integrity

• Privacy - 47/84

Privacy, personal or private information

• Beneficence - 41/84

Benefits, beneficence, well-being, peace, social good, common good

• Freedom and autonomy - 34/84 Freedom, autonomy, consent, choice, self-determination, liberty,

empowerment

• Trust - 28/84

#### Trust

• Sustainability - 14/84

Sustainability, environment (nature), energy, resources (energy)

• Dignity - 13/84

#### Dignity

• Solidarity - 6/84

Solidarity, social security, cohesion

However, despite an apparent agreement that AI should be 'ethical', there is debate about both what constitutes 'ethical AI' and which ethical requirements, technical standards and best practices are needed for its realization.

## **THANK YOU**

