Artificial Intelligence in Medicine: Today and Tomorrow

Giovanni Briganti, MD

Contact

Email: giovanni.briganti@ulb.be
Website: https://giovannibriganti.com
Twitter: @giovbriganti

Section 1

Introduction

Subsection 1

Innovation through Medical Technologies

From tongue depressors to wearables: what happened to medical technologies?

Medical technologies

- Early diagnosis
- Fewer complications
- Optimize treatment
- Reduce length of hospitalization

Smart medical technologies

- High computational power on the go
- Artificial Intelligence (AI) powered applications

Explaining “techtusiasm”

Why do patients easily adopt medtech?

4P medicine is enabled

Increased autonomy in various contexts

- Keep electronic personal health records
- Monitor vital functions with biosensors
- Reach optimal therapeutic compliance

Medtech empowers the rise of the “patient-partner”

Subsection 2

Rise of Medical AI

AI - Back to basics

AI: *perceiving*, *reasoning*, and *acting* computation

Machine learning: improving from experience

- Supervised learning: prediction from labeled data
- Unsupervised learning: prediction from unlabeled data
- Random forest (decision trees)
- Artificial Neural Networks (hidden layers and n neurons per layer)

Deep learning: decreasing number of n neurons per layer

- Low computational resources needed $>$ big / temporal data

Statistics v Machine Learning

Statistics $>$ Theory - Hypothesis testing - Low dimensional - Reasonable n

Machine learning $>$ Data - Predictability - High dimensional - Very high n

Origins of Augmented Medicine

FDA Approval of several AI-based algorithms

Bridging the gap with other digital tools:

- Surgical navigation systems /Computed assisted surgery
- Virtuality-Reality continuum tools

The war on AI: physician resistance

- Lack of background knowledge
- Failures of the early digitization process (physician burnout)
- "Will AI steal my job?"
- World-wide lack of legal framework (What if?)

Subsection 3

Applications of AI in Medicine

Cardiology and Pulmonology

Atrial fibrillation, the first use-case

- AliveCor > *Kardia* (2014)
- *Apple Watch 4* (2018)

Prediction of cardiovascular risk from electronic health records

Pulmonary function tests

- Decision support

Endocrinology and Nephrology

Continuous glucose monitoring

- Medronic $>$ *Guardian*
- Medtronic + IBM $>$ Prediction
- Reduce stigma
- Confidence $><$ failure to regulate

Decline in GFR

Progressive IgA Nephropathy

- Risk assessment

Gastroenterology

Wide range of AI applications $<$ deep learning

Process images in endoscopy & ultrasound

- Detection of abnormal structure
- Live clinical support decision

Machine learning $>$ prediction of outcome, survival, risk of metastasis

Neurology

Epilepsy

- Empatica > *Embrace*
- Dermic captors to detect seizures
- Alert family and physicians
- Soon: prediction?

Gait, posture and tremor

- Quantitative assessment
- Multiple sclerosis
- Parkinson
- Huntington

Pathology and Radiology

Paige.ai $<$ breakthrough status FDA

- Memorian Sloan Kettering $<$ 1 million images
- Diagnose cancer in computational histology

Radiologists vs AI: deep learning as efficient radiologists (meta-analysis)
BUT

- 99% of studies with NO reliable design
- 1/1000 of studies compared with other source populations
- *Need of extensive validation through clinical trials*

The promise of Ambient Clinical Intelligence (ACI)

Administrative burden is a major issue in healthcare

- Indirect patient care time $> 80\%$
- Main source of burnout
- Natural Language Processing is part of the solution

ACI: sensitive, adaptive and responsive digital environment around the physician and the patient

- Analyzing and writing interview report
- Fill electronic health record
- Decision support

Subsection 4

Validation of AI-based technologies

Towards a replication crisis?

Challenge 1: clinical validation of core concepts and tools

- Lack of primary replication (no other source than training and testing set)
- Solution: *open data and open science*

Challenge 2: the problem of overfitting

- Models optimally fit training data set but do not replicate
- Solution: *reevaluation and recalibration after adoption*
- Solution: *development of algorithms to fit larger communities and subgroups*

Challenge 3: the study of AI vs physicians

- Not the best way to tackle the issue of performance
- Solution: *study the combined force of AI and physicians*

Subsection 5

Ethical implications

The issue of ongoing monitoring

Medtech: 1000 billion $ 2019

- Increasing % due to retail to younger populations

Redefining the concept of "healthy individual"

- Young individual: not the primary target consumer profile?
- The concern of the quantified self

Tech + government deals > large scale distribution to induce lifestyle change

- Risk of increasing stigma on disadvantaged citizens
- Reduce access to health benefits
- Ex: Deep Mind, Nightingale, Singapore

Data ownership

Two-decade old debate

Option 1: common ownership of data

- Profit to development of personalized medicine

Option 2: patient ownership of data

- Improvement of information sharing
- 1 on 1 data use agreements

Consensus from recent epistemological works is shifting towards Option 2

Subsection 6

Reshaping education

Rise of the augmented doctors

Hybrid medical curricula medicine-engineering

- Different from biomedical engineering $>$ clinical background
- New profile of augmented doctors
- New bachelor, new MD, ongoing education

Need: guide hospitals and public institutions through the digital transition

- Augmented doctors for hospital leadership
- Augmented doctors for public policy
- Augmented doctors for research and development

Subsection 7

Pitfalls and challenges in medical AI innovation

Is it too late to board the medical AI train?

- Advances in AI driven by tech giants and their academic/hospital partners
- Europe lacks a tech giant of her own
- European health institutions strive to assume the cost of the digital evolution

A closer look on resistance from medical professionals

AI-powered medicine is frowned upon by many clinicians.

- Threats on the workforce
- Dehumanization of medicine
- Risks of continuous medical surveillance and Security concerns
- Malpractice responsibility (legally-responsible AI vs producer/doctor responsibility) $>$ *garantie humaine (human safety net)*
- A moral obligation to use AI in the future?

A closer look on resistance from medical professionals

Medtech startups face the all-powerful wall of the hospital world

- Lack of bridges between tech and medical universes
- AI innovation is ostracised to the tech world
- We need to innovate *hand in hand* !

Other actors than tech are very interested in the medical AI revolution

- Insurances
- Nutrition companies
- Wellness and Sport companies
- Retail companies

Exit the patient, enter the client

Why is profit market interested in healthcare?

Sharing care missions leads to market capture!

Profit market is interested in easy medicine!

- Basic services
- The chronic patient
- Telemedicine

Ex. Walmart Health

Moving forward with our fears: why AI will not steal our job (but will change the way we do it)

If history taking, diagnosis and treatment is automatized, the definition of doctor stays unchanged.

We are left with our original roles: communication, health advocacy, management, research, collaboration, and medical expertise.

Why we need to look closer

The next decade will be a turning point in many political, bioethical, clinical and social standards that define healthcare.

The competency shift initiated by profit market is likely to isolate European healthcare institutions if no wake-up call.

We need to move forward with our digital fears: they are critically slowing down healthcare innovation.

Subsection 8

Conclusion

Conclusion: An agenda for 2030

- Medtech as support
- Study physician + AI
- Build bridges for integrative clinical solutions
- Translational clinical trials

Healthcare actors are to use their position of privilege to lead innovation.

Thank you!