Augmented Medicine in the time of COVID19

Reshaping healthcare with AI and medtech

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Law, Cognitive Technologies and Artificial Intelligence

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From tongue depressors to wearables
What happened to medical technologies?

- Medical technologies
  - Early diagnosis
  - Fewer complications
  - Optimize treatment
  - Reduce hospital stay length
- Smart medical technologies
  - High computational power on the go
  - Artificial Intelligence (AI) powered applications

Explaining “techthusiasm”
Why 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

→ The empowered “patient-partner”

Rise of medical AI
Back to basics

- AI: *perceiving*, *reasoning*, and *acting* computation
- Machine learning: improving from experience
  - Supervised learning: data is labeled → prediction
  - Unsupervised learning: data is unlabeled → prediction
  - 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 → big/temporal data

Rise of medical AI
Statistics v Machine Learning

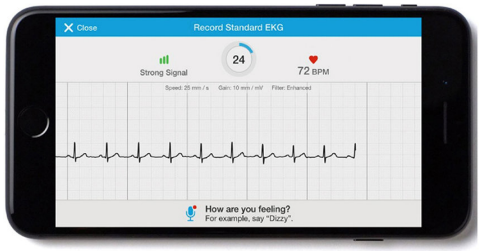
Statistics	Machine Learning
Theory	Data
Hypothesis testing	Predictability
Low dimensional	High dimensional
Reasonable n	Very high n (big data)

Origins of Augmented Medicine

- FDA approval of several AI-based algorithms
- Bridging the gap with other digital tools:
  - Surgical navigation systems/computer-assisted surgery
  - Virtuality-Reality continuum tools
- The war on AI: physician resistance
  - Unpreparedness due to lack of background knowledge
  - Failures of the early digitization processes $<$ physician burnout
  - "Will AI steal my job?"
  - World-wide lack of legal framework (What if?)

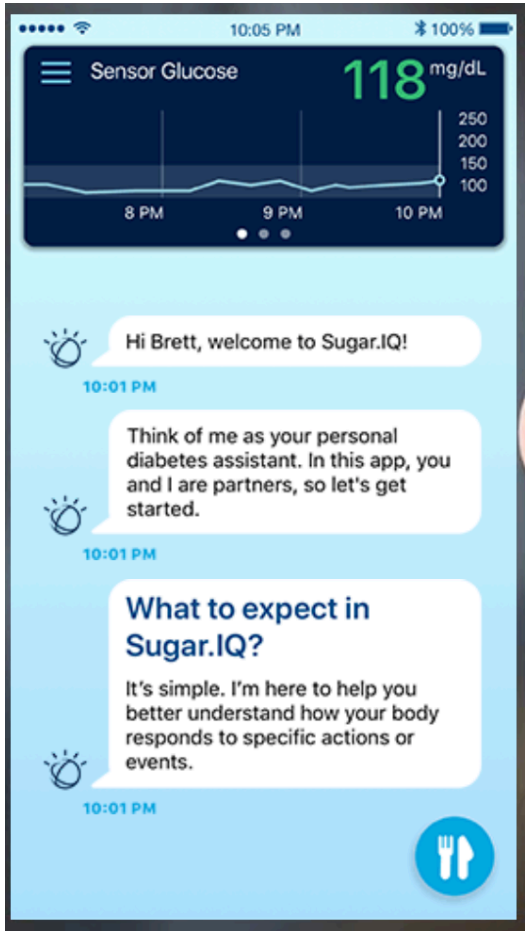
Applications of AI in medicine
Cardiology and Pulmonology

- Atrial fibrillation, the first use-case
  - AliveCor (2014) > Kardia
  - Apple Watch 4 (2018)
- Prediction of cardiovascular risk
  - From electronic health records
- Pulmonary functions tests
  - Decision support



Applications of AI in medicine
Endocrinology and Nephrology

- Continuous glucose monitoring
  - Medtronic > Guardian
  - Medtronic + IBM > prediction
  - Reduce stigma
  - Confidence >< failure to regulate
- Decline in GFR
- Progressive IgA nephropathy
  - Risk assessment

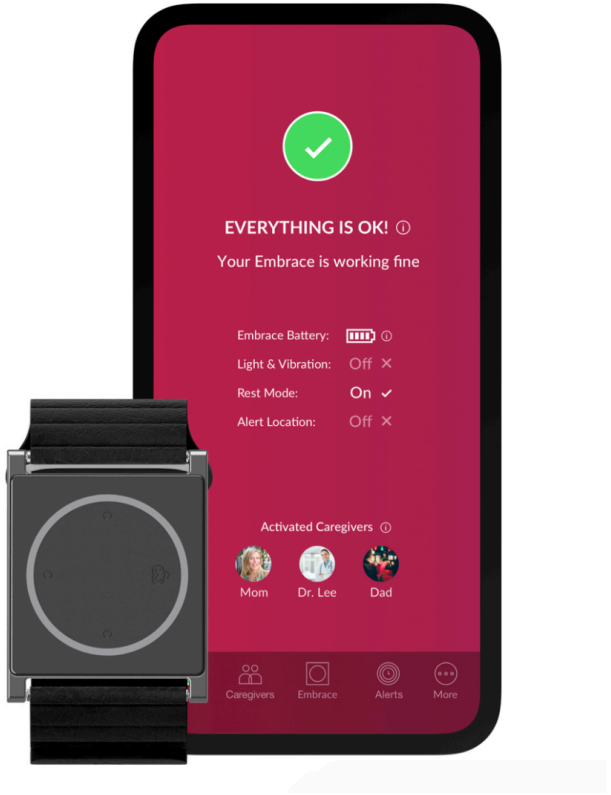


Applications of AI in medicine
Gastroenterology

- Wide range of AI applications
- Deep learning
  - process images in endoscopy & ultrasound > detect abnormal structures
- Machine learning
  - Predict outcomes, survival, risk of metastasis

Applications of AI in medicine
Neurology

- Epilepsy
  - Empatica > Embrace
  - Dermic captors to detect seizure
  - Alert family & physicians
  - Soon: prediction?
- Gait, posture and tremor
  - Quantitative assessment
  - Multiple sclerosis
  - Parkinson
  - Huntington



Applications of AI in medicine
Pathology and imaging

- Paige.ai < breakthrough status FDA
  - Memorian Sloan Kettering < 1 million images
  - Diagnose cancer in computational histology
- Radiologists vs AI
  - Meta-analysis: deep learning as efficient radiologists
  - BUT
    - 99% of studies with NO reliable design
    - 1/1000 of studies compared with other source populations
    - Need of extensive validation through clinical trials

Other fields of augmented medicine

- Evidence-based practice
  - Data driven platforms of clinical decision support
- Outsourcing genomics
- Outsourcing clinical trials > cash for data platforms
- Smart history taking
- Teleconsultation

Fighting COVID19 with AI

- Am I at risk? Smart contact tracing
  - Awaiting regulation in Belgium as of May 2020
- Am I symptomatic ? Outsourced history taking
  - Validated in Belgium
- Where should I be tested? Matching algorithms
  - Current under development in Belgium, used in UK
- Diagnosis → CT Scan
  - Developed and FDA-approved, but not used in Belgium

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

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

Ethical implications
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

Reshaping education
On the need to educate augmented doctors

- To enlighten and manage the digital transition in healthcare and public institutions
- To educate patients and peers
- To be a safety net in complex medical and bioethical issues
- To drive innovative research projects and policies

Reshaping health
On the need to have augmented care

More and more healthcare institutions are including CMIOs in the medical leadership.

- The war on AI?
- Or war between AI-powered doctors and regular ones?
- The turning point on legal, bioethical, clinical and social standard
- The competency shifts initiated by tech giants will isolate European healthcare institutions if no wake-up call
- Re-placing academia as the heart of scientific developments in the AI field

We need European-made experts to deal with these challenges by our standards of care.

Exit the patient, enter the client
The intrusion of new players in healthcare

- Medtech startups and the hospital wall
  - Lack of bridges between med and tech worlds
  - Innovation ostracised
- New players interested by augmented health
  - Insurance companies
  - Nutrition companies
  - Wellness and sport
  - Retail

Exit the patient, enter the client
On why profit is interested in healthcare

- Mission sharing for market capture
- The economic actors are interested in easy tasks
  - Basic services
  - Chronic patients
  - Telemedicine
  - Ex. Walmart Health

Innovating done right during the pandemic

We already know what tools to choose

- Outsourcing healthcare is how we support hospitals during the pandemic
- History taking
- Smart contact tracing (debated)
- Prediction
- Pseudonymization
- Matching algorithms

Innovating done right during the pandemic

What is taking so long?

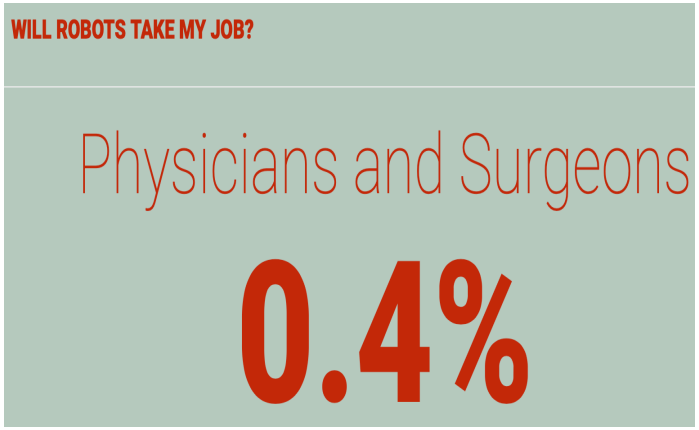
- Too many solutions
- Each solution tackles 1 (very) specific issue
- Each solution operates in a narrow digital ecosystem
- Interdisciplinary solutions emerging from collective expertise from different stakeholders are the way to go
  - And healthcare professionals should be actively included in their development!
- Invest in security
- Transparency in development

Moving forward with AI
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

Conclusions
AI will not change what it means to be a doctor

- MedTech as support
- An agenda for 2030
  - Study physician + AI
  - Translational clinical trials
- A position of privilege
  - But education needed to provide future leaders with competencies to lead innovation



Thank you!

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