Big Data, advanced analytics and personalised cancer care

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World Cancer Leaders’ Summit
Setting the ground
Artificial Intelligence: Concepts, potentials and caveats

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Artificial Intelligence 101: Concepts, Potentials and Caveats

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Rapid advances in the information sciences, coupled with the political commitment to broad extensions of health care, promise to bring about basic changes in the structure of medical practice. Computing science will probably exert its major effects by augmenting and, in some cases, largely replacing the intellectual functions of the physician. As the "intellectual" use of the computer influences in a fundamental fashion the problems of both physician manpower and quality of medical care, it will also inevitably exact important social costs — psychologic, organizational, legal, economic and technical. Only through consideration of such potential costs will it be possible to introduce the new technology in an effective and acceptable manner. To accomplish this goal will require new interactions among medicine, the information sciences and the management sciences, and the development of new skills and attitudes on the part of policy-makers in the health-care system.
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Main take home message(s):

Still far from clinical realm, hence truly quantifying impact

Pressing need for regulatory frameworks and incentives for VBHC (all about outcomes)
HC & AI

The Dunning–Kruger effect

I know everything
There’s more to this than I thought
Trust me. It’s complicated
I’m never going to understand this
It’s starting to make sense
Huh?

Knowledge in Field

Confidence

Hype? | Hope? | Both?: Let’s be cautiously optimistic
What's macallit?

**Aglet**

- keeps the fibers of the lace from unraveling
- firmness and narrow profile that makes easier:
  - to hold
  - to feed through eyelets
Rumpelstiltskin Principle

“tonight tonight, my plans I make, tomorrow tomorrow, the baby I take. The queen will never win the game, for Rumpelstiltskin is my name”

Naming something gives you power over it: vocabulary allows you to think/talk about it.
What this is not (only) about...

Intelligence:

- the ability to learn or understand or to deal with new or trying situations (Merriam-Webster)
- reason | plan | solve | abstract | comprehend | learn | “catching out” | “making sense” | “figuring out”
- $F = T \nabla S_T$
  (force that acts so as to maximize future freedom of action)
Common Definitions

- The design, study and construction of programs that behave intelligently (Tom Dean)
- The enterprise of constructing a system that can reliably pass the Turing test (Matt Ginsberg)
- Test of a machine's ability to exhibit intelligent behaviour equivalent to, or indistinguishable from, that of a human. (Alan Turing)
AI Deeper Definition

Thinking | Perception | Action
AI DEEPER DEFINITION

Models Targeted at
Thinking | Perception | Action
AI Deeper Definition

Representations that Support Models Targeted at

Thinking | Perception | Action
AI Deeper Definition

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Representations that Support

Models Targeted at

Thinking | Perception | Action
AI Deeper Definition

Algorithms | Procedures | Methods Enabled by
Representations that Support
Models Targeted at
Thinking | Perception | Action
AI LANDSCAPE

Artificial Intelligence
- Deduction, Reasoning, Problem Solving
- Knowledge Representation
- Planning
- Perception: Computer Vision
- Social Intelligence

Machine Learning
- Supervised Learning
  - Decision Tree Learning
  - Inductive Logic Programming
- Unsupervised Learning
  - Clustering
  - Sparse Dictionary Learning
  - Genetic Algorithms
- Reinforcement Learning
  - Bayesian Networks
  - Deep Learning

Deep Learning
- Subset of machine learning in which multilayered neural networks learn from vast amounts of data
- Algorithms whose performance improve as they are exposed to more data over time

Artificial Intelligence
- A program that can sense, reason, act, and adapt
Value in understanding method? Or OK with black box?
Some Considerations

Panda
57.7% confidence
Some Considerations

Panda 57.7% confidence

Gibbon 99.3% confidence

Artificial things are susceptible to artificial problems
Some Considerations

Aftershock prediction
13,451 DNN vs 1 neuron logistic regression
(distance and slip)

Same performance

Novel does not necessarily mean better insights or accuracy
GE Healthcare Receives FDA Clearance of First Artificial Intelligence Algorithms Embedded On-Device to Prioritize Critical Chest X-ray Review

Sep 12, 2019

Maybe less ambitious... but more supportive
1995...

**Netscape: Welcome to Netscape**

- Back  Forward  Home  Reload  Images  Open  Print  Find  Stop

**Netsite:** http://home.netscape.com/


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**WELCOME TO NETSCAPE**

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**SECURE COURIER**

Netscape announces the first open, cross-platform "digital envelope" protocol, to be supported by Intuit, MasterCard, and others.

**WINDOWS 95 NAVIGATOR BETA**

Download the latest beta release of Netscape Navigator, specially tuned to take advantage of Win 95 interface enhancements and features.
Use information you do have, to generate information you don’t have.
Anatomy of decisions and Tasks

Input → Prediction → Action → Outcome

Judgment

Learning → Feedback
Field that treats ways to deal with, analyze, systematically extract information from data sets:

- Too large or complex (usually unstructured)
- Exceed capacity of usual software to process (within acceptable time and value)
- Challenges: capturing, storage, analysis, search, sharing, transfer, visualization, querying, updating, privacy, sources.... FDR

4Vs: Volume | Variety | Velocity | Veracity

Dilemma: Utility or Futility?
Divorce rate in Maine correlates with
Per capita consumption of margarine

Correlation: 99.26% (r=0.992558)

Data sources: National Vital Statistics Reports and U.S. Department of Agriculture
“Intelligent”: able to understand meaning of information

Information is acquired/delivered/conveyed in a selected **representation language**.

- **Source** ➔ **Receiver**
  - Same “language” (**meaningful exchange**)
  - Interpret as intended by source’s **semantics**

**Data** ➔ **Information** ➔ **Knowledge**
Summary

- Definitions of AI from Pragmatic, Scientific and Economic angles.
- AI is not a panacea: data & judgement (still) define value.
- Importance of semantically-rich data underscored.
- Discovery ≠ change

Overarching Goal:
convey concepts that enhance thoughts on the subject, in order to (try) enrich the roadmaps towards action.
THANKS!

Any questions?

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The dinner later today :-)
Transforming healthcare through a new era of data and analytics

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Roche Pharmaceuticals, United Arab Emirates
Combining data with advanced analytics delivers value in personalised care for patients

Meaningful data at scale

Advanced analytics

Value

Smarter, more efficient R&D

Improved access and personalised care

Deeper scientific insights
 Faster, more efficient trials

Enhanced patient-therapy matching
 Value-based healthcare
 Care optimisation
Technological advances are increasing the volume and the variety of healthcare data

Volume of healthcare data

- 2005: 130 exabytes
- 2015: 7,910 exabytes
- 2020: 35,000 exabytes

Generation and application of data and insights throughout the patient journey for improved patient experience and outcomes

- Early and accurate diagnosis
- Continuous and remote patient management
- Tailored care plan
- Full access to optimal care intervention
- Data & insights
Genomic sequencing improves diagnosis rates and reduces healthcare costs

- Improved diagnosis of disease
- Influence on treatment decision
- Higher avoidance of morbidity

Rapid Whole Genome Sequencing

Standard Genetic Testing

Saved >$800K
Avoided >124 inpatient days

Digital tools provide reliable and timely data for patients’ day-to-day experience with disease.

365 days living with a disease

The patient recall period is generally limited to a few days, limiting the insight he/she can transmit to a physician.

Monitoring symptoms daily
Apps, sensors and wearables.
A successful learning healthcare system integrates all insights to deliver better care, more cost-effectively and sustainably.

Principles of a learning healthcare system:

- Culture of learning and data sharing (both clinical and Real World Data) between healthcare practitioners, institutions and across healthcare systems and geographies.
- Better outcomes for patients.
- Improved efficiency and sustainability of healthcare.
- Greater scope for ongoing and future scientific and medical innovation.
How can public policy help make data-driven personalised healthcare a reality?
Core policy areas to advance personalised healthcare

- Data infrastructure
- Access to data
- Innovation
- Adoption
- Health system transformation
Priority initiatives in the Middle East to accelerate the delivery and adoption of personalised healthcare

- Advance data residency to enable data capturing
- Unlock access to comprehensive genomic profiling
- Best-practice exchange enabling governmental initiatives
Personalised healthcare benefits the entire healthcare ecosystem

- Payors and Governments
- Physicians and healthcare providers
- Patients
- Policy-makers
- Regulators

Pharmaceutical companies
Thank you

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A new vision for cancer: data, technology and human touch

Marius Geanta, MD
President, Centre for Innovation in Medicine
Romania
Cancer: heterogeneous environment
Romanian Presidency of EU Council 2019

A new vision for cancer in European Union: Data, technology and human touch.

Digital Twins

Learning and literate health systems

Position Paper
Published by Centre for Innovation in Medicine in the context of Romanian Presidency of Council of European Union.
Digital Twins

Will every human in the Future have his/her personal model as protection against dangers, as aid for the doctor to personalise therapy and prevention and as support in wellness ("pursuit of happiness) applications?
Learning and literate health systems

- Bismarck or Beveridge? “The same dinosaur”
- Institutional innovation
- Financing and efficiency of spending
- Lack of leadership and (human) resources
- Political will / coherence
- “Old habits die hard”
Our model
Building the ecosystem around BigData and Analytics

• Environment (leading Romanian health communication platform)

• Agenda setting (Science meets Politicians, State of Innovation in Romania, Personalised Medicine Conference)

• Targeted interventions (Personalised Medicine Committee, E-Health Agency)

Up Next
Bucharest Health Innovation Cluster to be launched in December 2019
Thank you

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