Will AI and Health-IT make your life easier and work more interesting?

……maybe….maybe not.!

Martin Than

Microsoft

WHAT'S NOT INCLUDED

- Robotics
- Virtual reality and augmented reality
- Health Informatics - connectivity
- Ethics

- Omics
- 3D – printing
- Drones

- TIME
- PEOPLE
- HUMANITY

AI

- 1 TO 1
- 1 TO MANY
- 1 TO ONE

Prof. Francis Peabody (Harvard 1927)

- A task of the doctor is to transform…

"*that case of mitral stenosis in the second bed on the left*"

into the complex problem of….

"*Henry Jones, lying awake nights while he worries about his wife and children*"

AI

Will make the clinician's job more interesting as it decreases the tasks that are routine

Will make the visible – become invisible (task burden)

also make the invisible – become visible (signals from data)

It is human + machine NOT human vs machine

like other technologies , will be hyped in the short term but deliver in the long term

We need to be patient-centric and have an awareness of inherent bias in AI

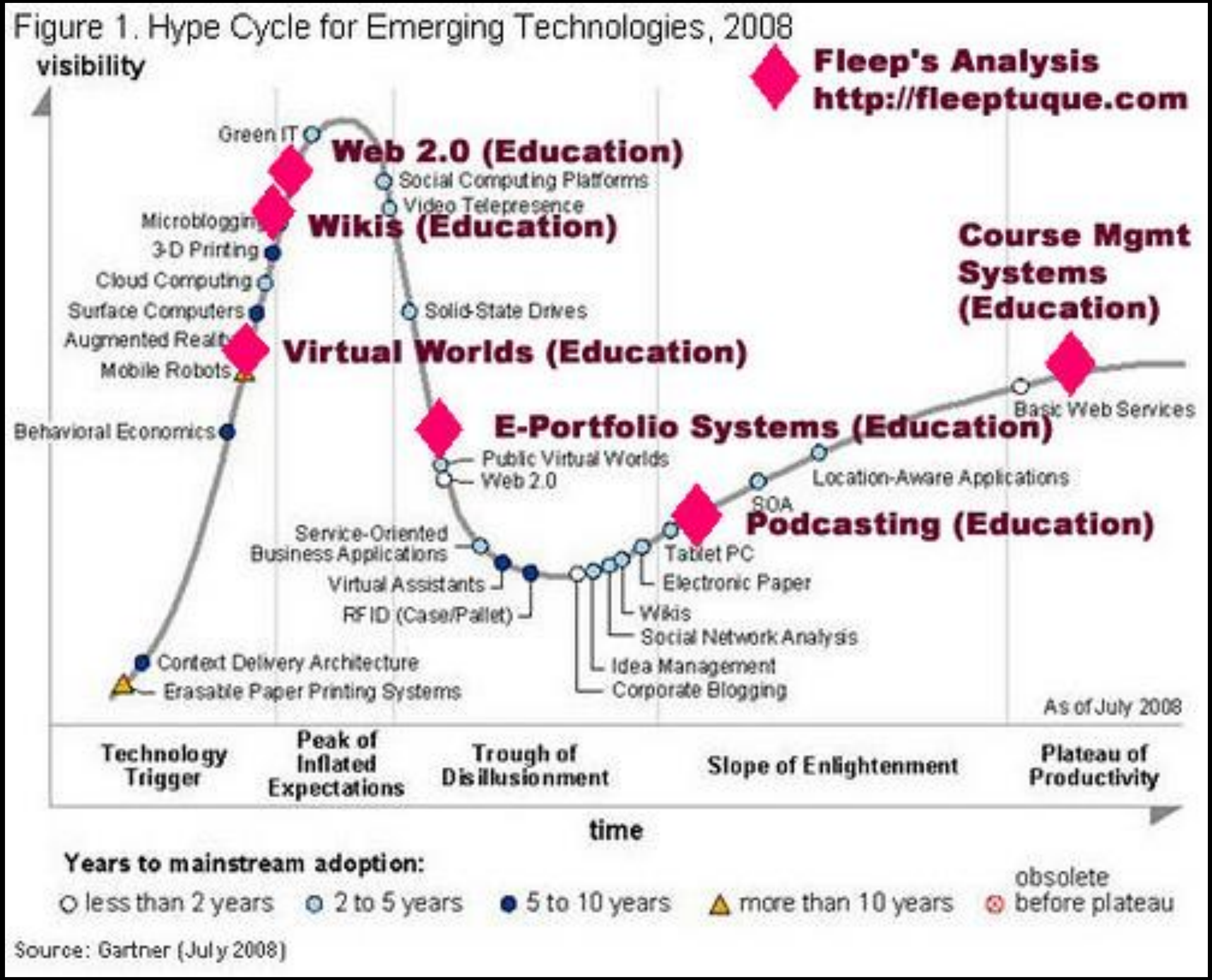
Figure 1. Hype Cycle for Emerging Technologies, 2008
visibility
Fleep's Analysis
http://fleeptuque.com
Green IT
Web 2.0 (Education)
Social Computing Platforms
Video Telepresence
Microblogging
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3-D Printing
Cloud Computing
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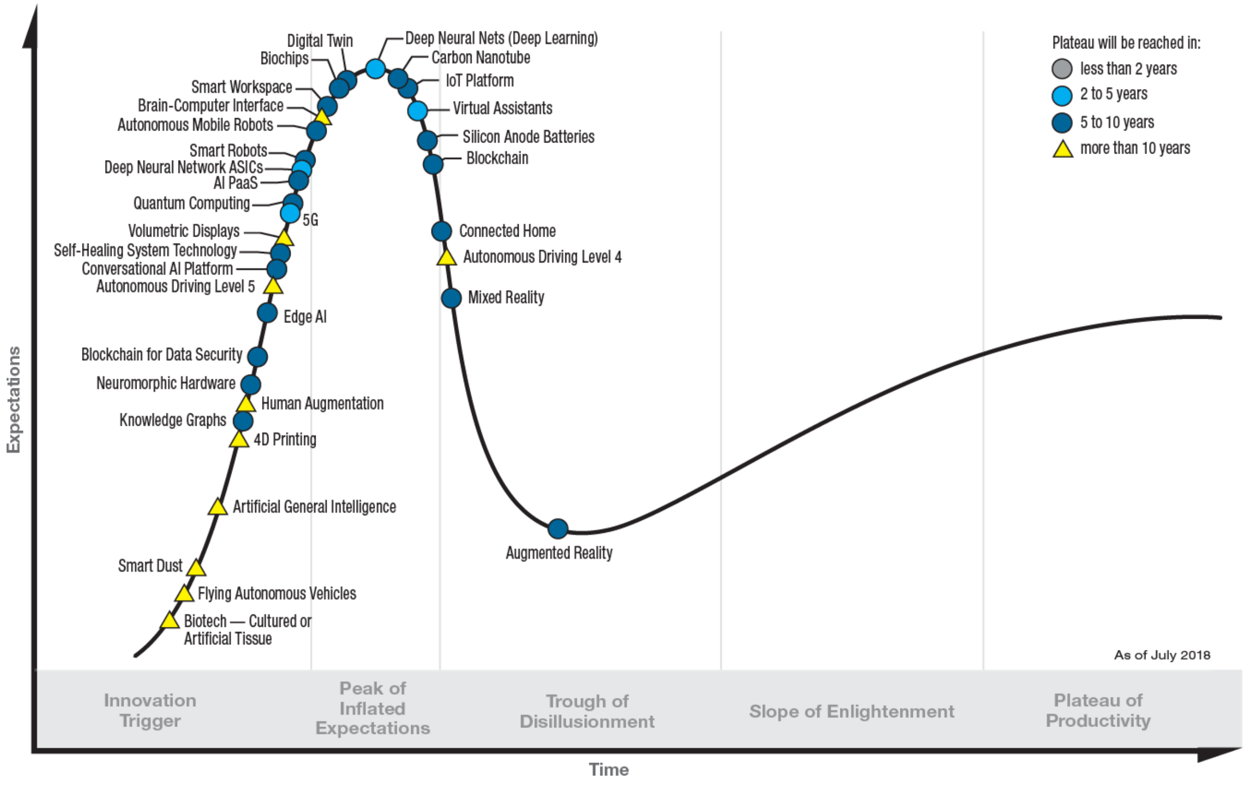
Virtual Worlds (Education)
Mobile Robots
Solid-State Drives
Course Mgmt Systems (Education)
Basic Web Services
Behavioral Economics
E-Portfolio Systems (Education)
Public Virtual Worlds
Web 2.0
Location-Aware Applications
SOA
Podcasting (Education)
Service-Oriented Business Applications
Tablet PC
Electronic Paper
Virtual Assistants
RFID (Case/Pallet)
Wikis
Social Network Analysis
Idea Management
Corporate Blogging
Context Delivery Architecture
Erasable Paper Printing Systems
As of July 2008
Technology Trigger
Peak of Inflated Expectations
Trough of Disillusionment
Slope of Enlightenment
Plateau of Productivity
time
Years to mainstream adoption:
less than 2 years
2 to 5 years
5 to 10 years
more than 10 years
obsolete before plateau
Source: Gartner (July 2008)

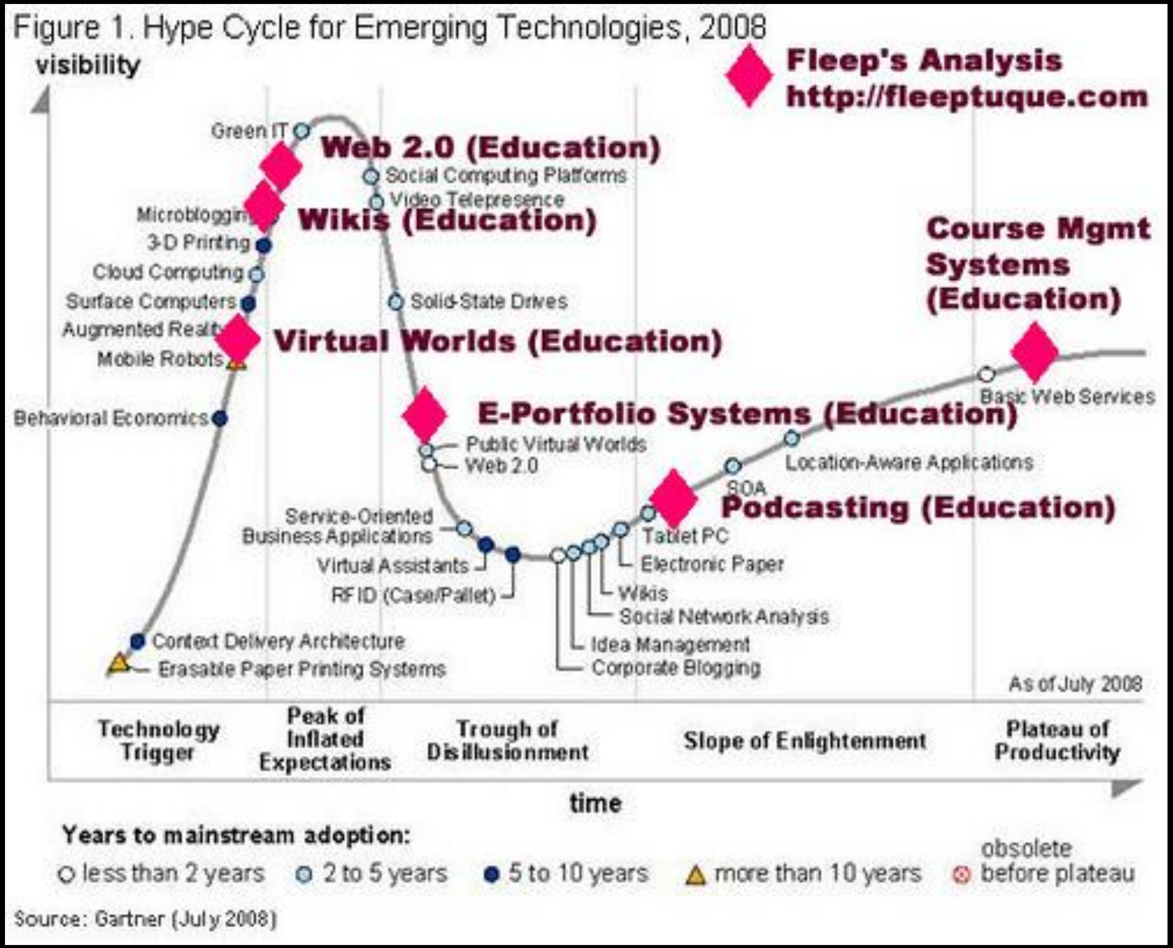
Hype Cycle for Emerging Technologies, 2018



gartner.com/SmarterWithGartner

Source: Gartner (August 2018)

Gartner®



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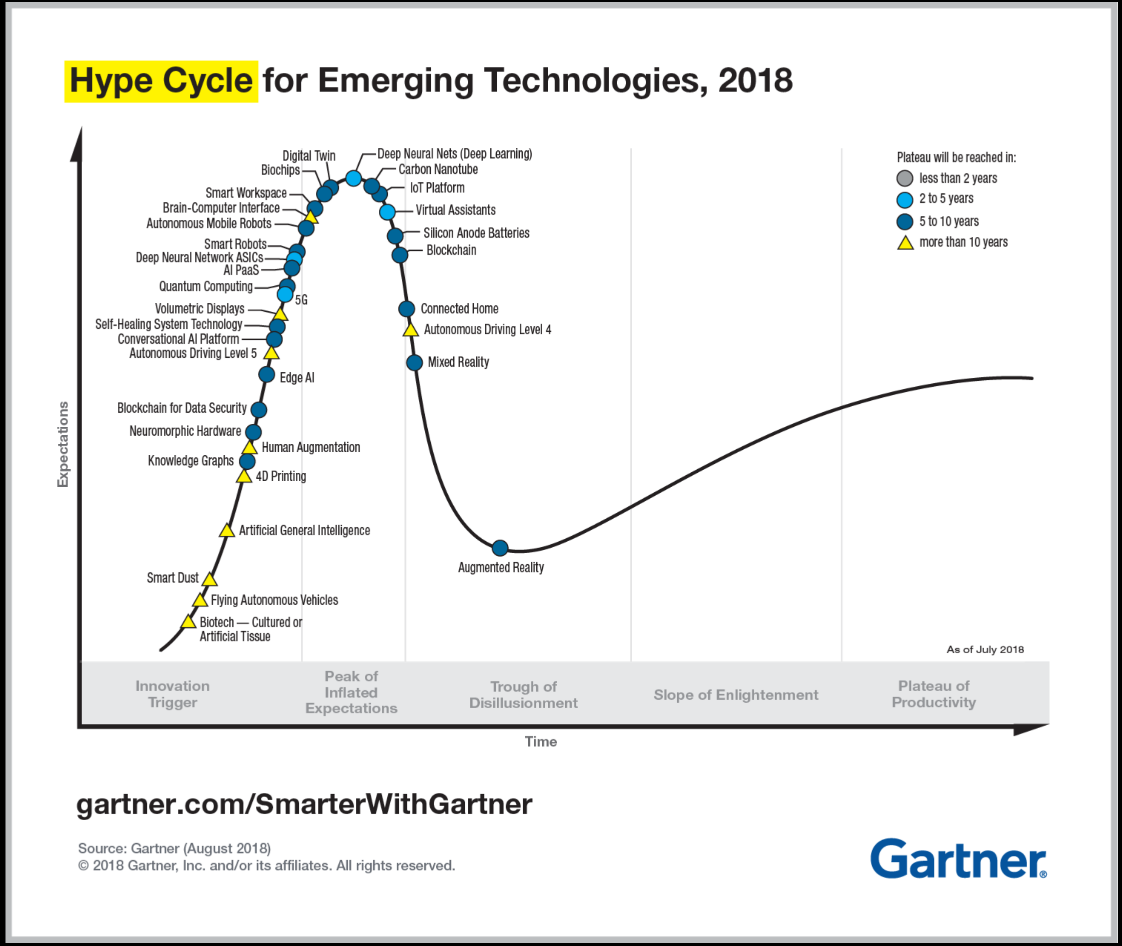

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Biochips
Deep Neural Nets (Deep Learning)
Carbon Nanotube
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Smart Workspace
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Silicon Anode Batteries
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AI PaaS
Quantum Computing
5G
Volumetric Displays
Self-Healing System Technology
Conversational AI Platform
Autonomous Driving Level 5
Connected Home
Autonomous Driving Level 4
Mixed Reality
Edge AI
Blockchain for Data Security
Neuromorphic Hardware
Human Augmentation
Knowledge Graphs
4D Printing
Artificial General Intelligence
Augmented Reality
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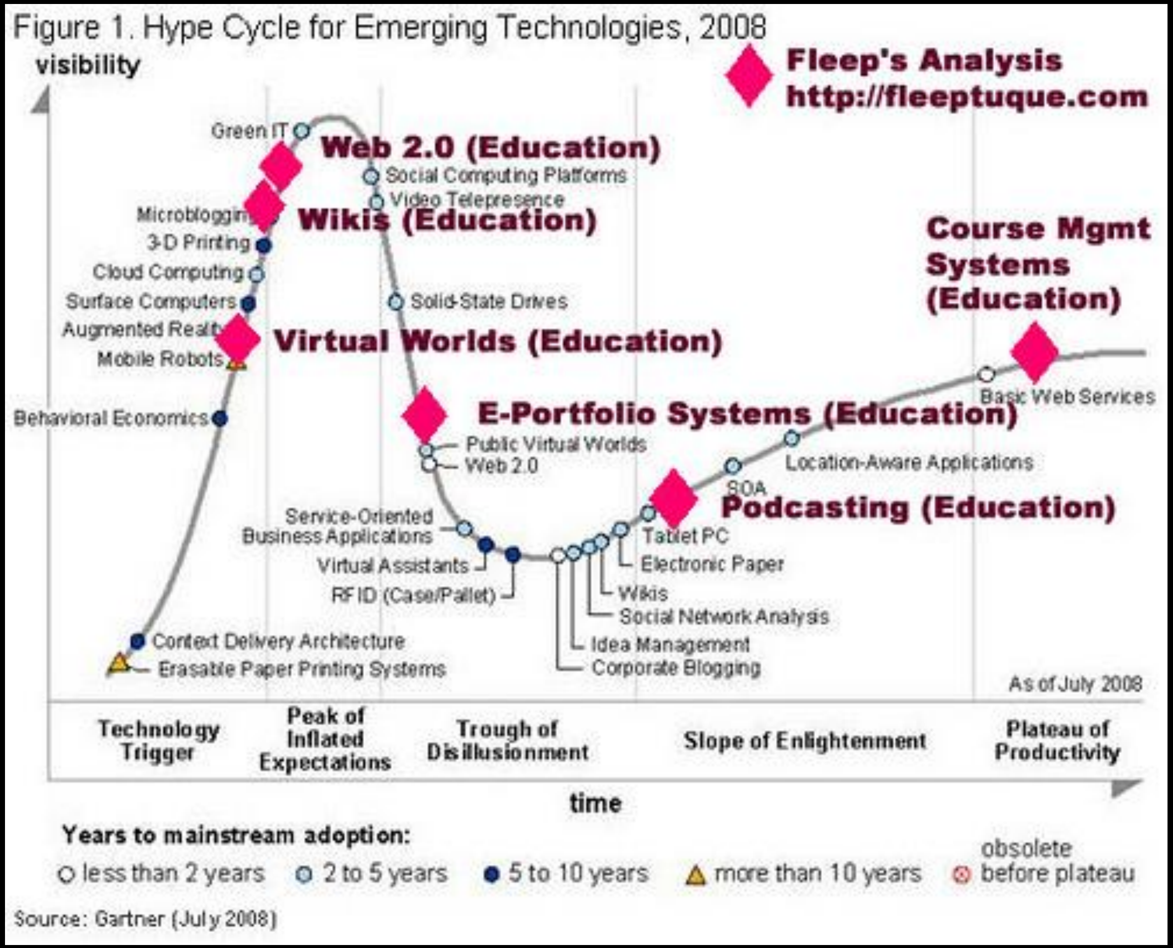
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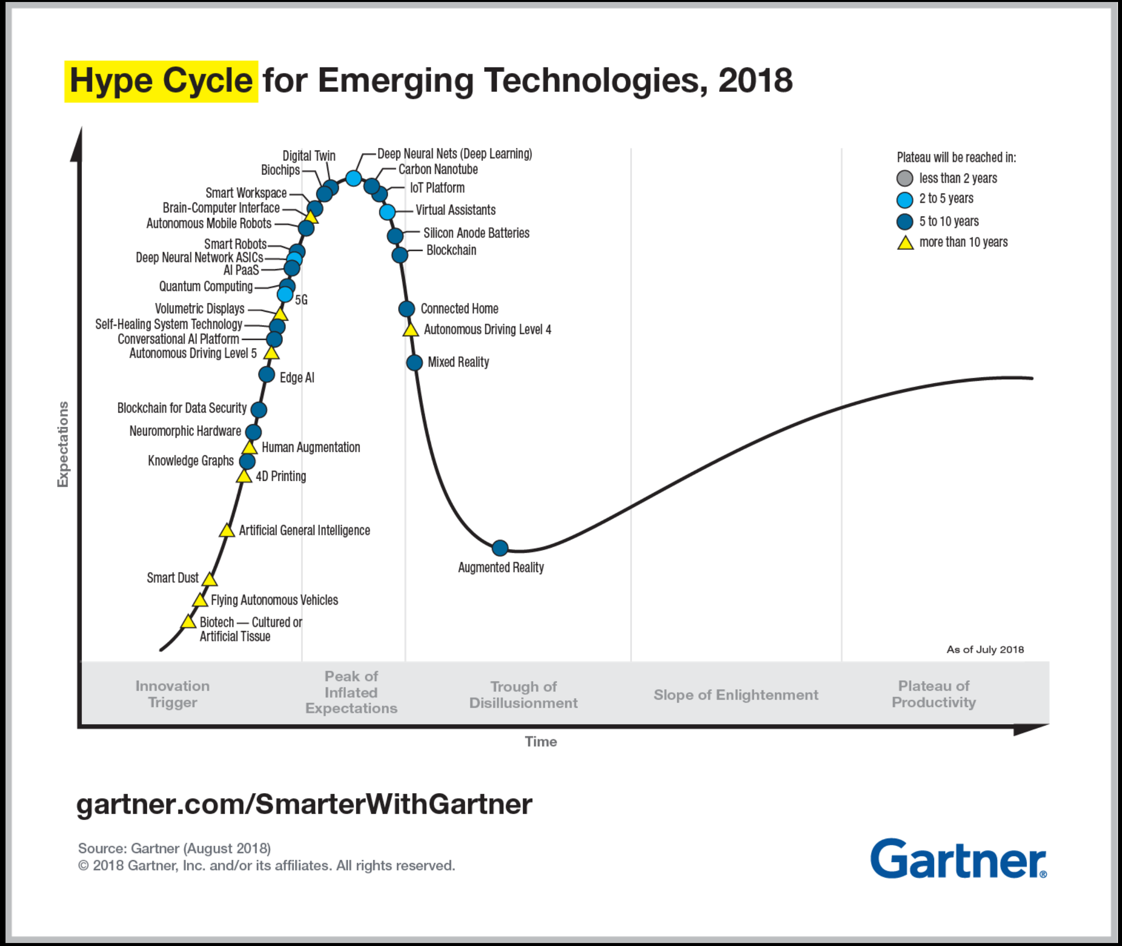
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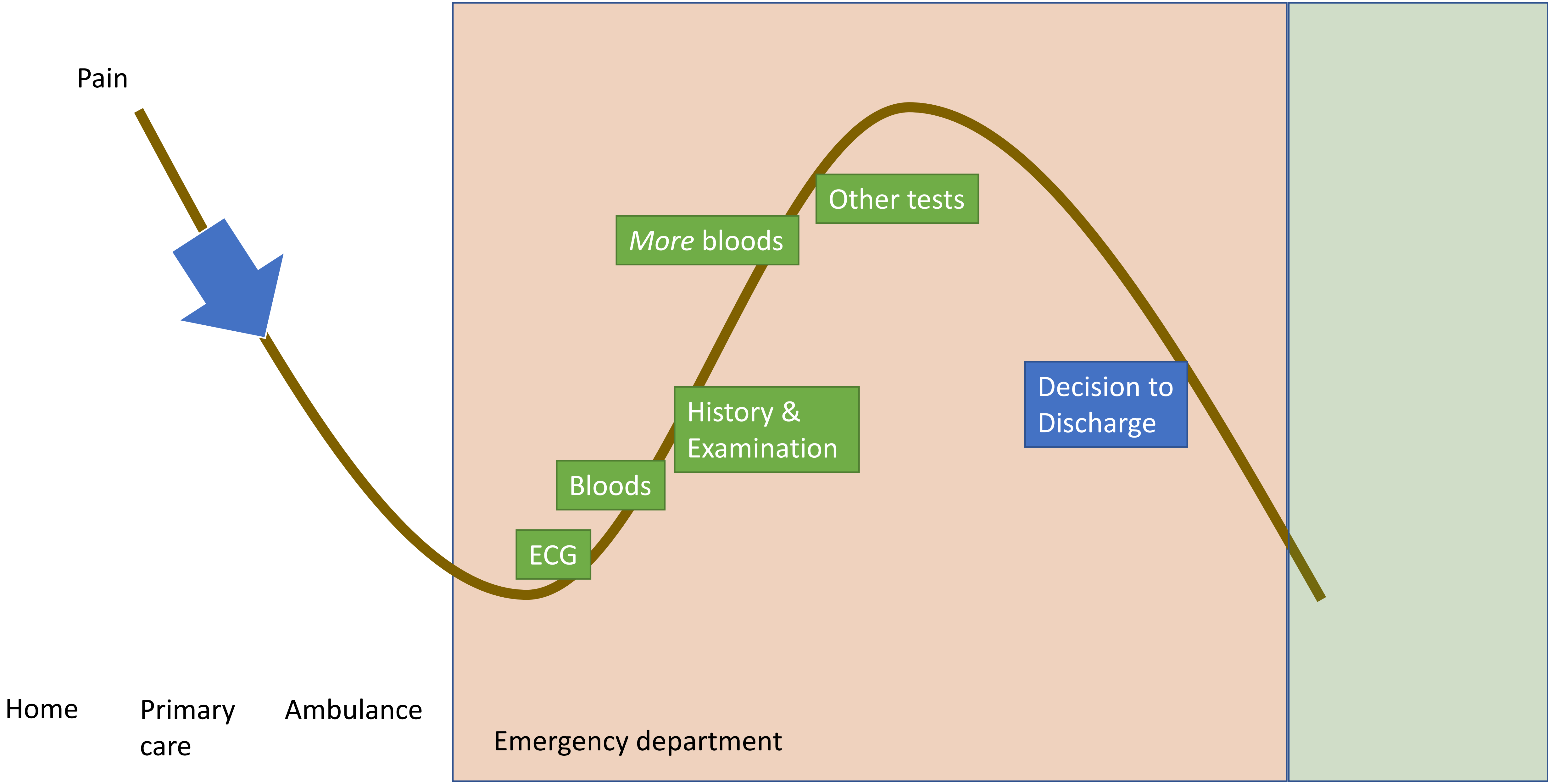
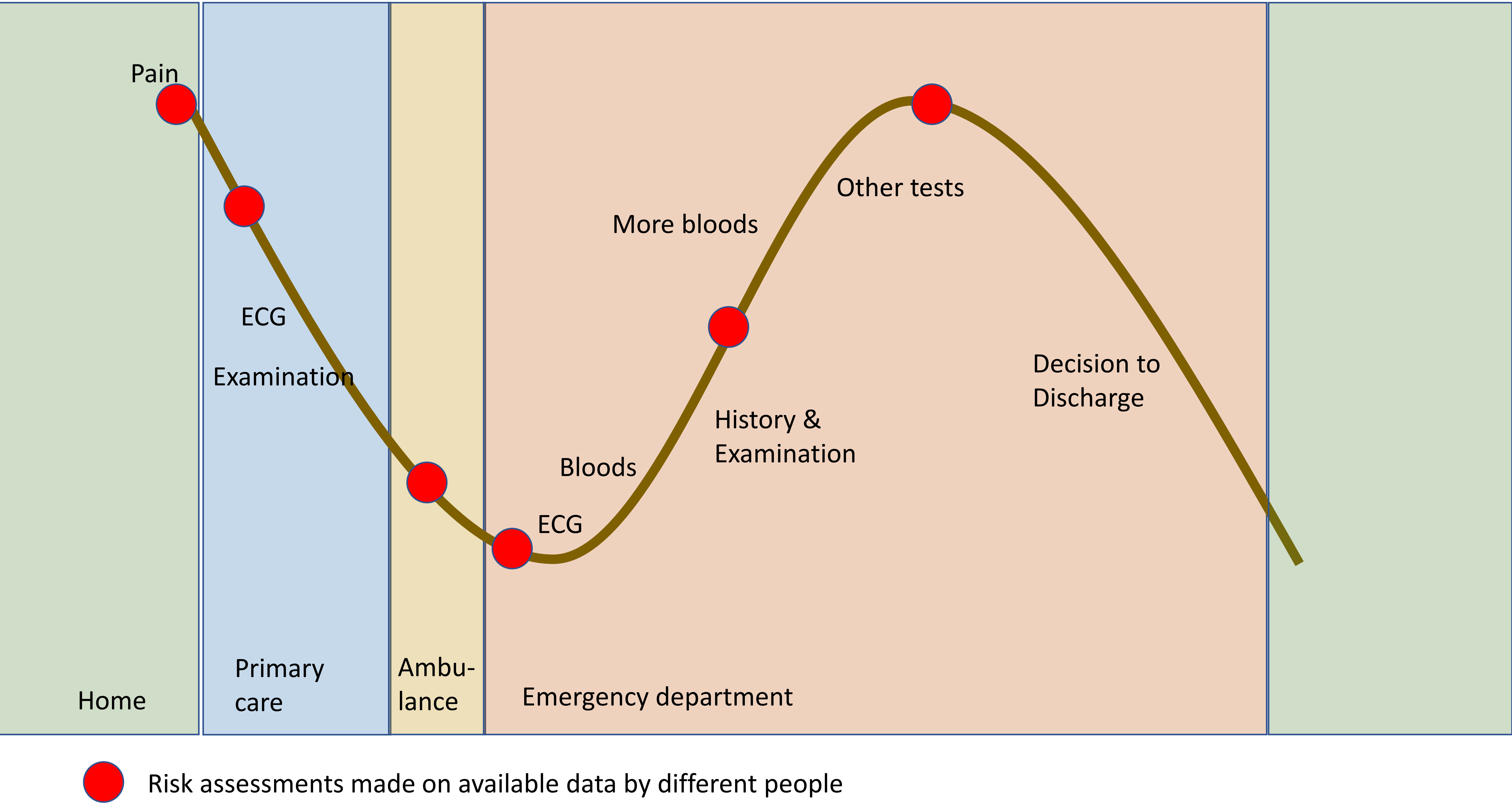
Gartner

EXPONENTIAL TECHNOLOGY CONVERGENCE

1. BIG DATA
2. PROCESSING POWER
3. DATA SCIENCE TECHNIQUES / AI / MACHINE LEARNING

EMERGENCY MEDICINE IS AN *ART* OF MAKING RAPID VITAL DECISIONS WITH INCOMPLETE INFORMATION


Pain
Other tests
More bloods
History & Examination
Decision to Discharge
Bloods
ECG
Home
Primary care
Ambulance
Emergency department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History &
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ECG
Home
Primary
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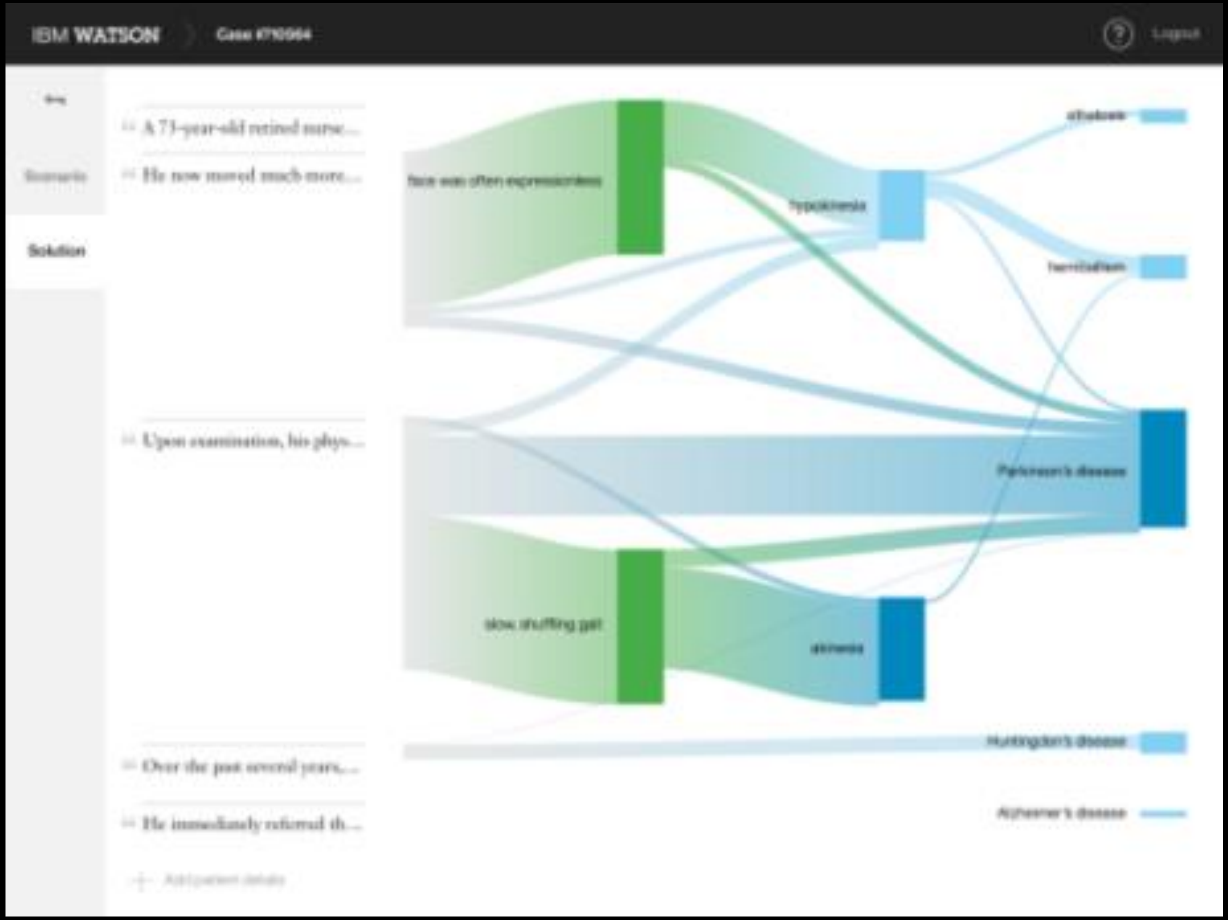
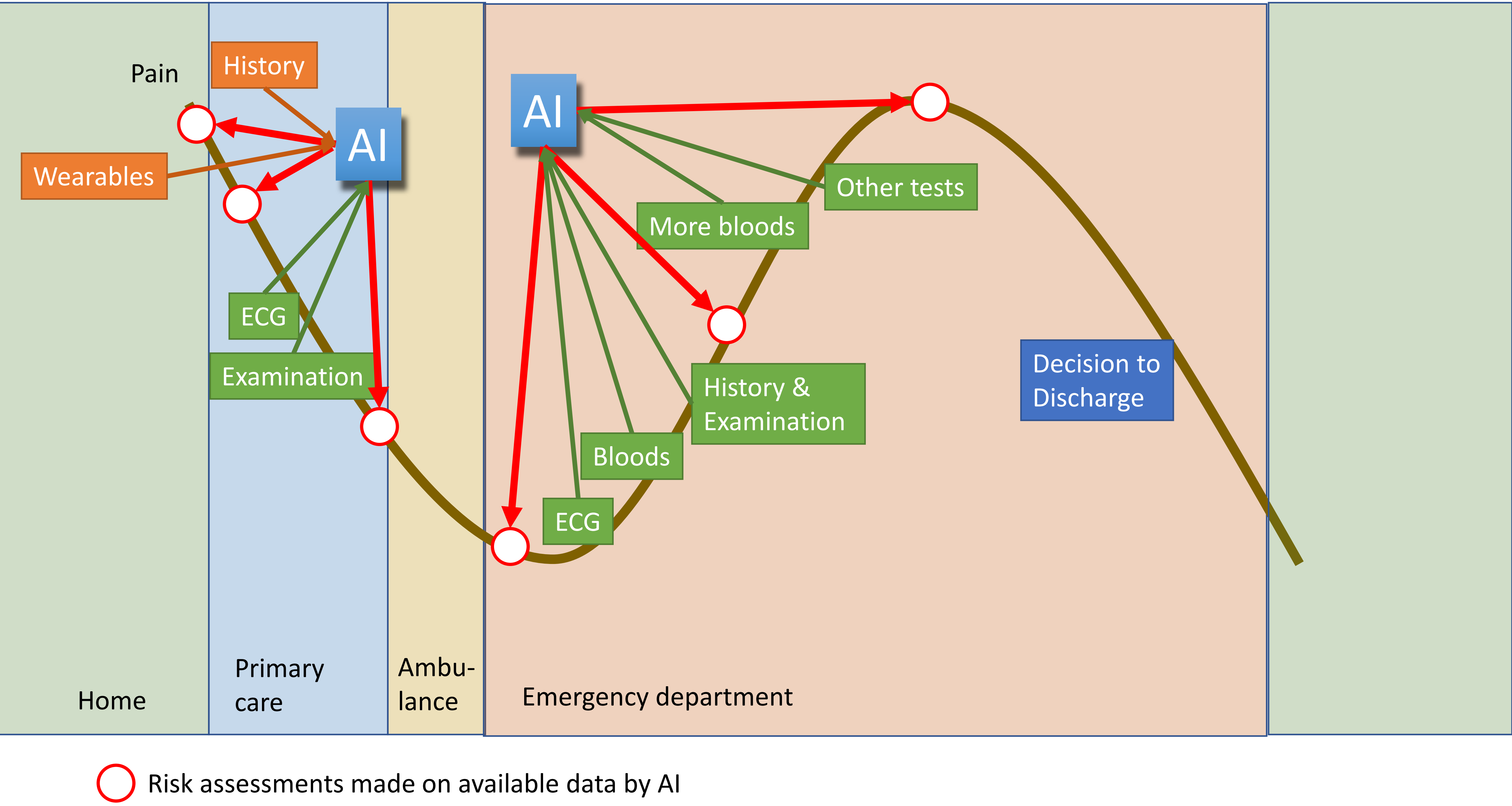
Ambu-
lance
Emergency department
Risk assessments made on available data by different people

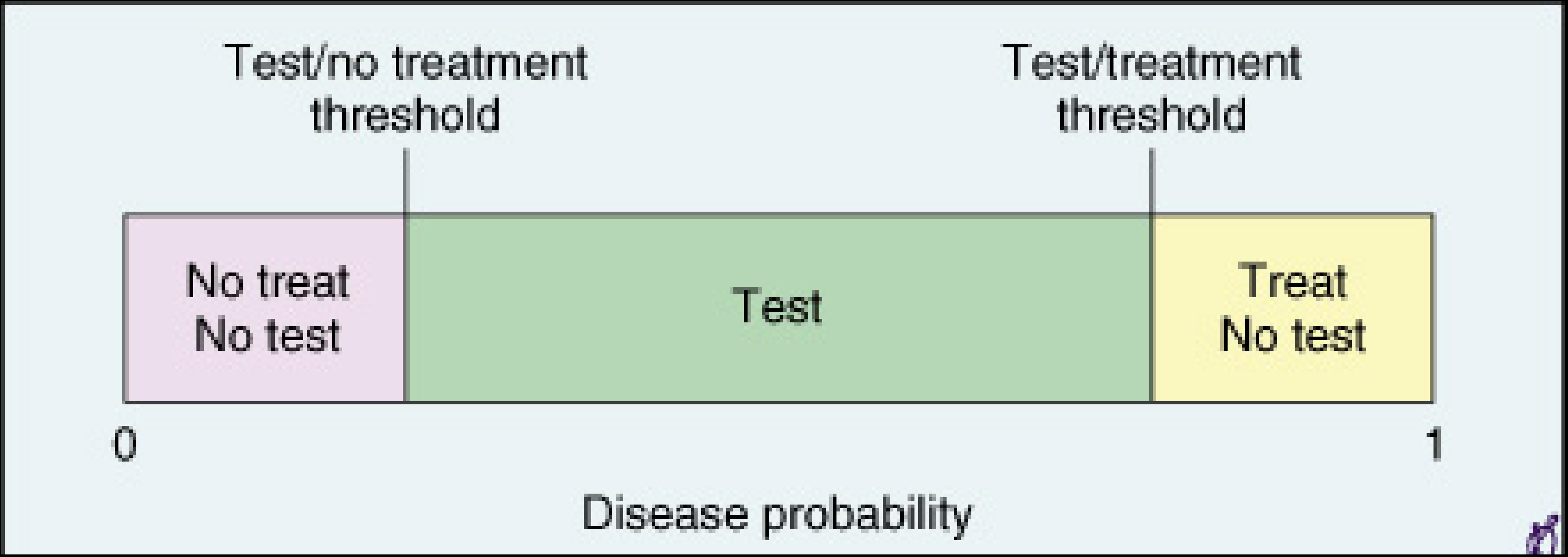
Background logic – Our subliminal thought process





Pain
History
Wearables
AI
ECG
Examination
AI
More bloods
Other tests
History &
Examination
Bloods
ECG
Decision to
Discharge
Home
Primary
care
Ambu-
lance
Emergency department
Risk assessments made on available data by AI

CLINICAL DECISION MAKING – Threshold theory



Pauker SG, Kassirer JP. The threshold approach to clinical decision making. *N Engl J Med.* 1980;3022:1109-1117.

Edaculator the ED ACS Calculator

Acute coronary syndrome risk score calculator based on the EDACS study

Learn more »

Calculate an EDACS score

Age 54 years old

Gender
- Male
- Female (selected)

Risk Factors*
- [ ] Known coronary artery disease
- [ ] Family history of premature coronary artery disease
- [x] Hypertension
- [x] Dyslipidaemia
- [ ] Diabetes Mellitus
- [ ] Current smoker

*Self-reported; if the patient does not know, the answer is 'no'

Symptoms and Signs
- [ ] Diaphoresis
- [x] Pain# radiates to arm, shoulder, neck or jaw
- [ ] Pain# occurred or worsened by inspiration
- [ ] Pain# is reproduced by palpation

#Pain that caused presentation to hospital

Edaculate!

Please note this score is only valid if:

- At least 18 years old
- Chest pain consistent with acute coronary syndrome
- Normal vital signs
- No ongoing pain or crescendo presentation

Your score is 11

This is a low risk* score

*see explanatory notes for interpretation

ransfer to hospital via

doses as long as blood

pain relief.

aboratory for rapid

w risk. Consider
lone.

rovide pain relief as

community.
patients in the

WHAT IS BIG DATA

There is no uniform definition of "big data" in health care, but it is often characterized by the 5 "Vs":

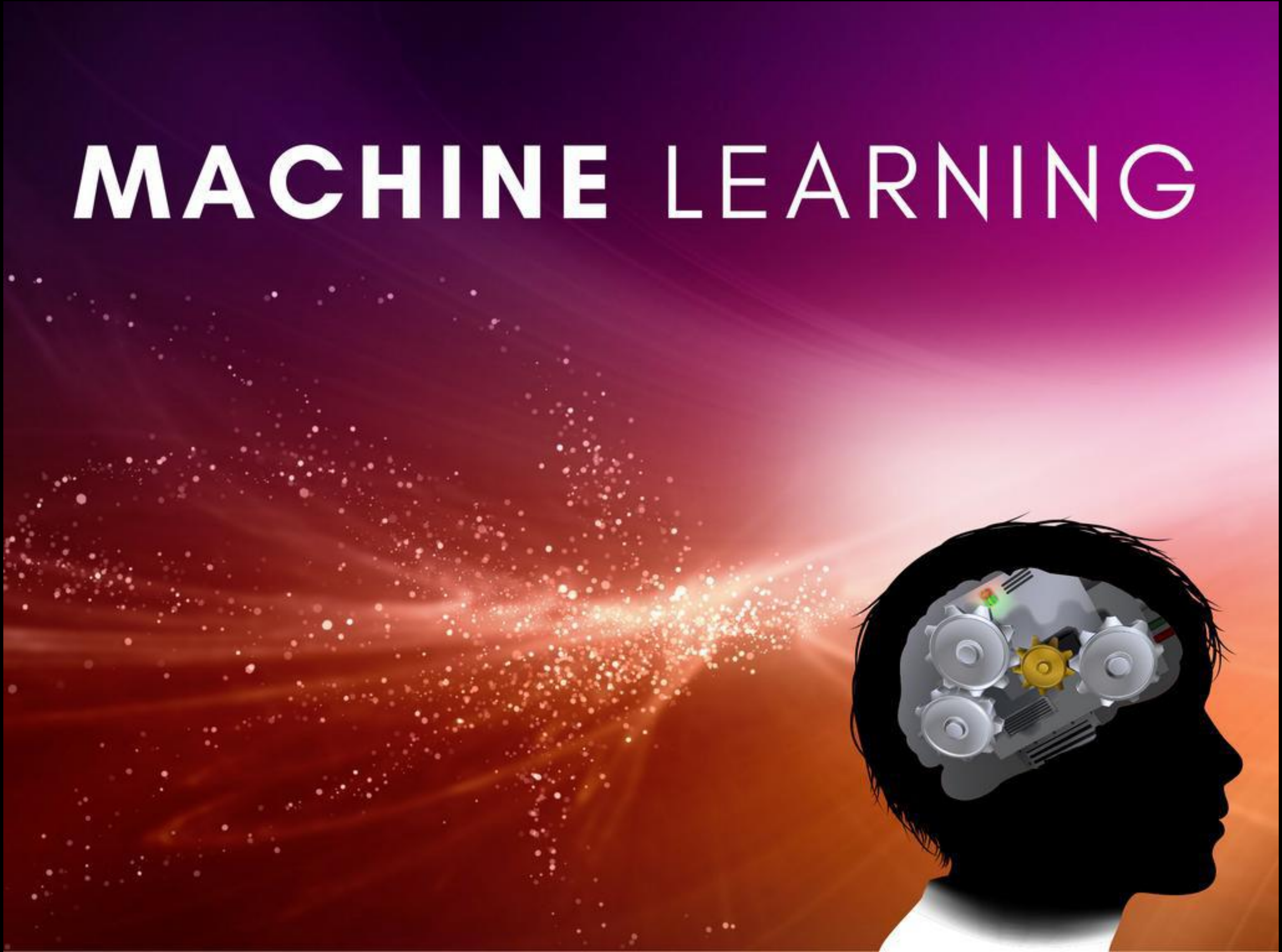
- ***VOLUME*** represents the size of a dataset, usually ranging from terabytes to zetabytes
- ***VELOCITY*** pertains to data in motion and the fast speed of the generation of new data
- ***VARIETY*** refers to data in various types and forms, and its resultant complexity
- ***VERACITY*** indicates the trustworthiness (? ambiguities due to data uncertainty and inconsistency
- ***VALUE*** refers to the additional worth that data can bring to generate knowledge

Patients like me

What if we could pool our clinical experience

Many predictors are not a dichotomous variable

- E.g. TROPONIN


MACHINE LEARNING

ORIGINAL ARTICLE LEADERSHIP

CrossMark

Machine Learning in Radiology: Applications Beyond Image Interpretation

EC: Editor's Choice

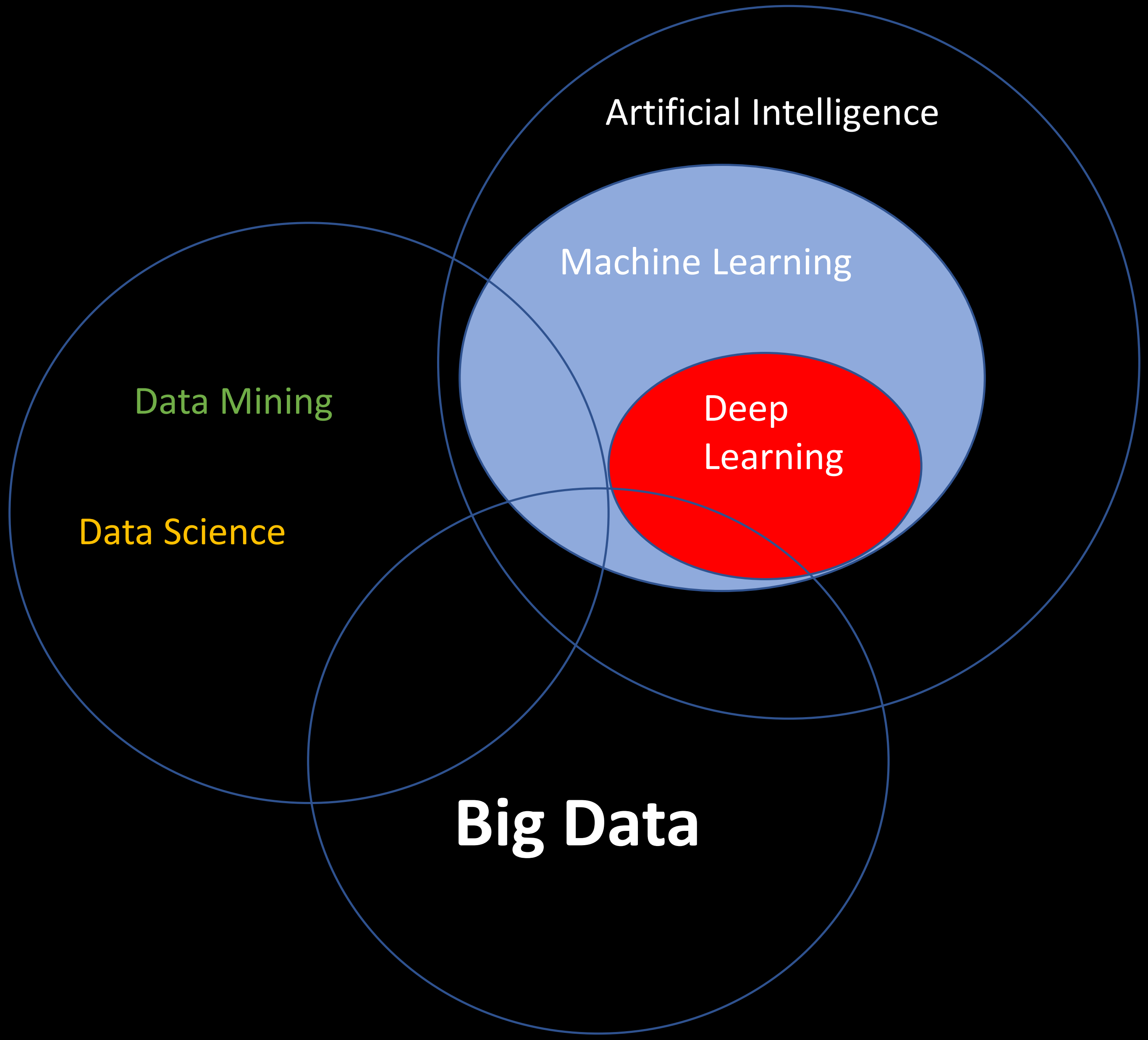
SA-CME

Paras Lakhani, MD[a], Adam B. Prater, MPH, MD[b], R. Kent Hutson, MD[c,h], Kathy P. Andriole, PhD[d], Keith J. Dreyer, DO, PhD[e], Jose Morey, MD[f,g,h], Luciano M. Prevedello, MD, MPH[i], Toshi J. Clark, MD[j], J. Raymond Geis, MD[j], Jason N. Itri, MD, PhD[g], C. Matthew Hawkins, MD[b]

NOVEMBER 15, 2017

Stanford algorithm can diagnose pneumonia better than radiologists

Stanford researchers have developed a deep learning algorithm that evaluates chest X-rays for signs of disease. In just over a month of development, their algorithm outperformed expert radiologists at diagnosing pneumonia.



CHANG AC.
Artificial Intelligence in Medicine:
Analytics and Algorithms, Big Data, Cognitive Computing, and Deep Learning in Medicine and Healthcare

SOME EXAMPLE TYPES OF MACHINE LEARNING

- Linear regression
- Logistic regression
- Linear Discriminant analysis
- Classification and regression trees
- Naive Bayes
- K-nearest neighbors
- Learning Vector Quantization
- Support vector machine
- LASSO
- Gradient Boosting
- Artificial neural network

coursera

edX

UDACITY

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ACADEMY

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Limitations to data sets

- Imaging,
- ICU,
- Process data

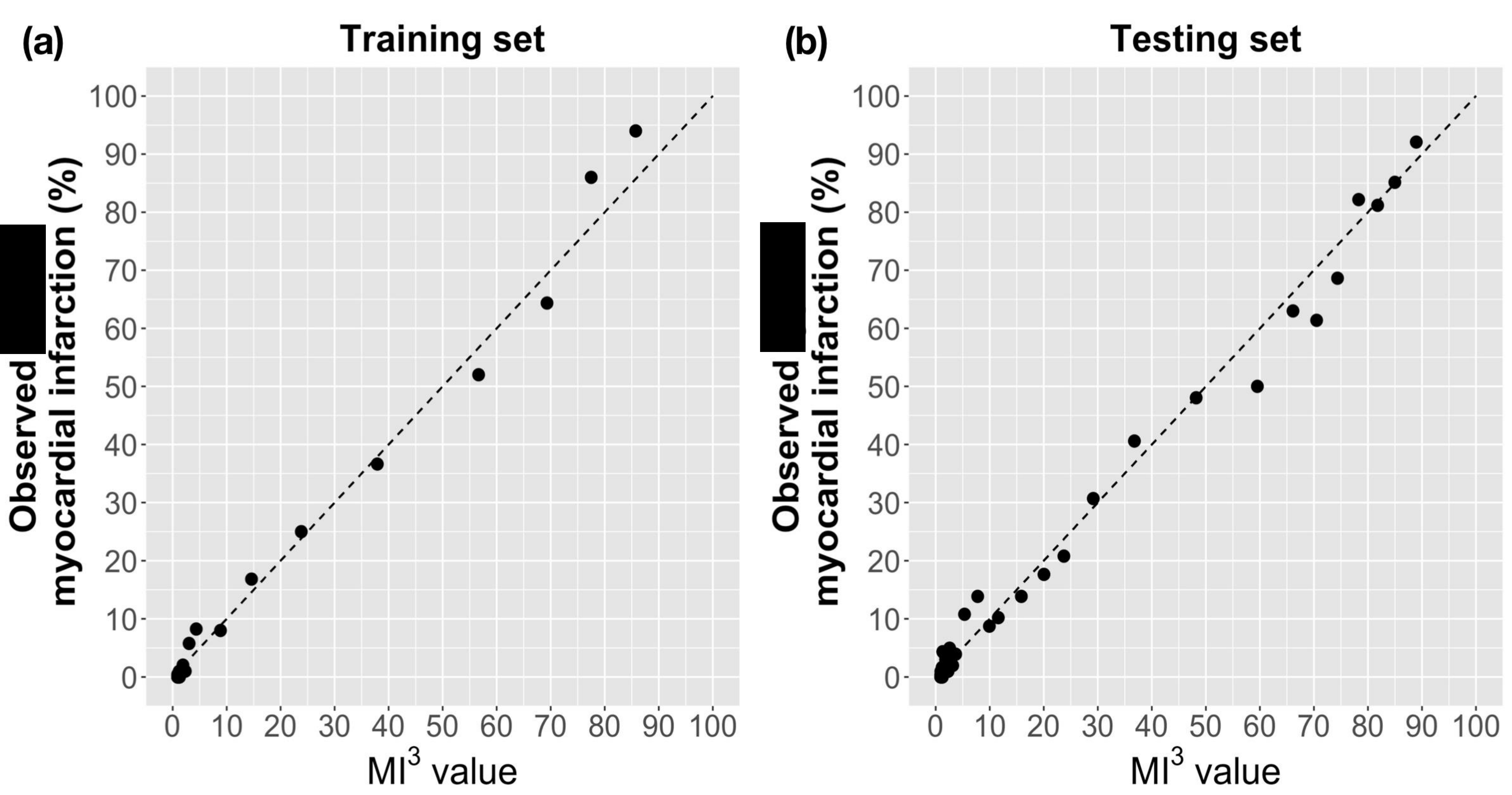
- 80% of medical data is UNSTRUCTURED

Model for MI^3 Based on Boosting Method

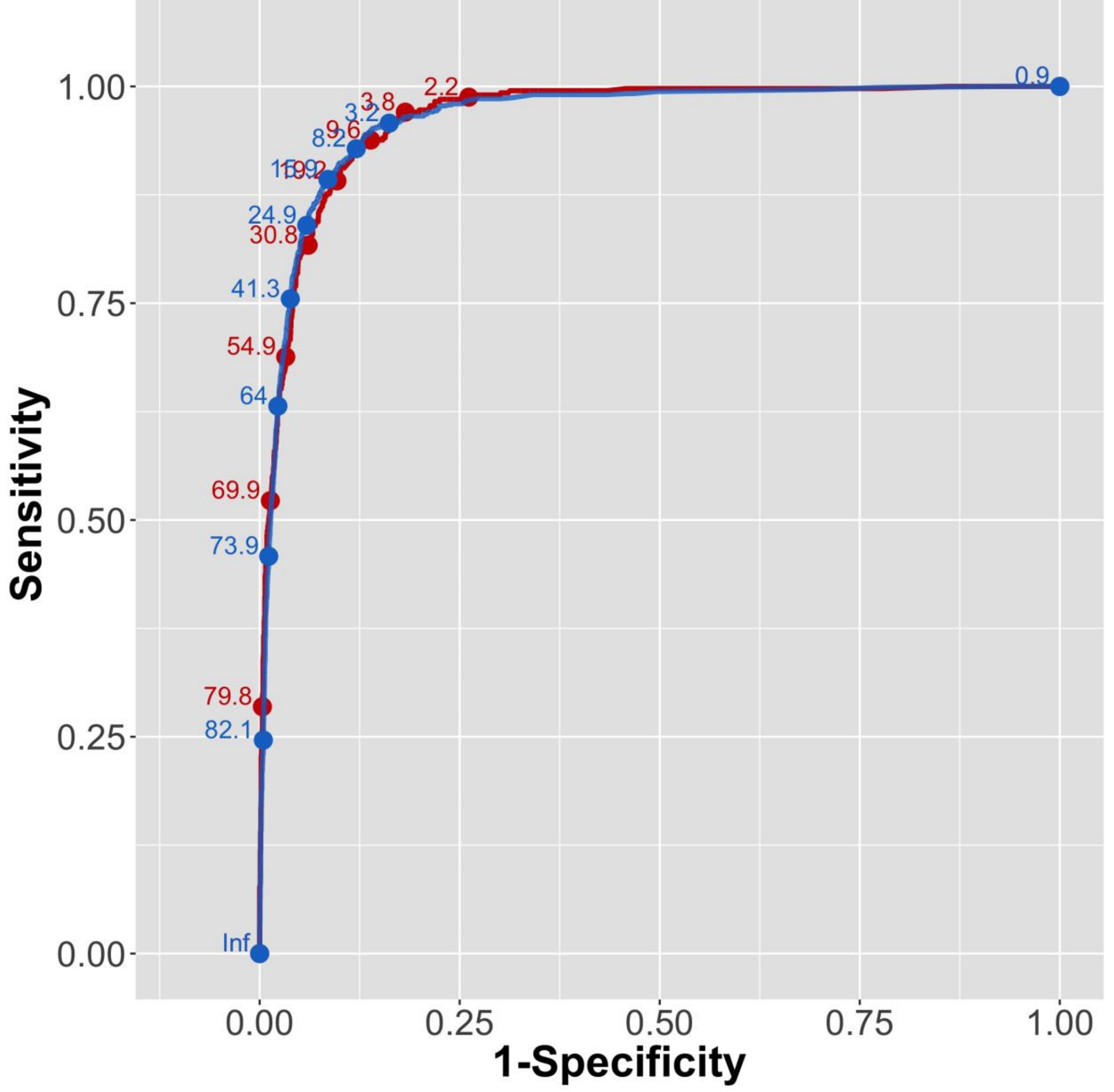
$$\log\frac{p_1}{1-p_1} = F_M(X) = F_0(X) + \sum_{i=1}^{M} a_i T_i(X)$$

p_1=probability of type 1 myocardial infarction and $T_i(X,\beta_i)$ is a decision tree of X = (*age category, sex category, high-sensitivity cardiac troponin I concentration at presentation, high-sensitivity cardiac troponin I concentration on repeat testing, rate of change of concentration*) characterized by parameters β_i, where M is the number of decision trees. a_i is the weighting for each decision tree.

Calibration



ROC curves for the MI³ index and myocardial infarction



Training

red: AUC 0.963

[95%CI: 0.956 - 0.971])

Testing

blue: AUC 0.963

[95%CI: 0.957 - 0.968])

A mock-up of how the algorithm may be presented to physicians and patients

AIM TO COMBINE INTO ONE INTERFACE

- MEDICAL RECORD
- CLINICAL GUIDANCE
- PREDICTION OF PROBABILITIES

DECISION-AID PROTOTYPE
LEAD DEVELOPER DR MARC GUTENSTEIN

ADVANTAGES

- Becomes the medical record and integrates with EHR
- Reduces error rate
- Prompts for other key differential diagnoses
- Will provide individualised probabilities
- Communication with patient create lay language discharge paperwork
- Facilitates nursing handover
- Constant collection of data

- MAKES LIFE EASIER FOR THE USER (e.g. experience of NZ police force)

Natural Language Processing (NLP)

- ALLOWS the computer to understand spoken as well as written human language

- USES techniques such as parsing,
  - which is the analysis of words in the sentence for grammar followed by a process of arranging the words that shows the proper relationship between these words.

- NLP COMPONENTS ARE:
  - natural language understanding (NLU) and
  - natural language generation (NLG)

- NLP is the intersection of AI and linguistics.

Journal of
Health & Medical Informatics

Hurrell et al., J Health Med Informat 2017, 8:6
DOI: 10.4172/2157-7420.1000297

Case Report Open Access

Use of Natural Language Processing to Identify Significant Abnormalities for Follow-up in a Large Accumulation of Non-delivered Radiology Reports

Michael Hurrell[1*], Alan Stein[2] and Sharyn MacDonald[1]

[1]*Department of Radiology, Canterbury District Health Board, University of Otago, Christchurch, New Zealand*
[2]*Department of Radiology, Hewlett Packard Enterprise, Palo Alto, USA*

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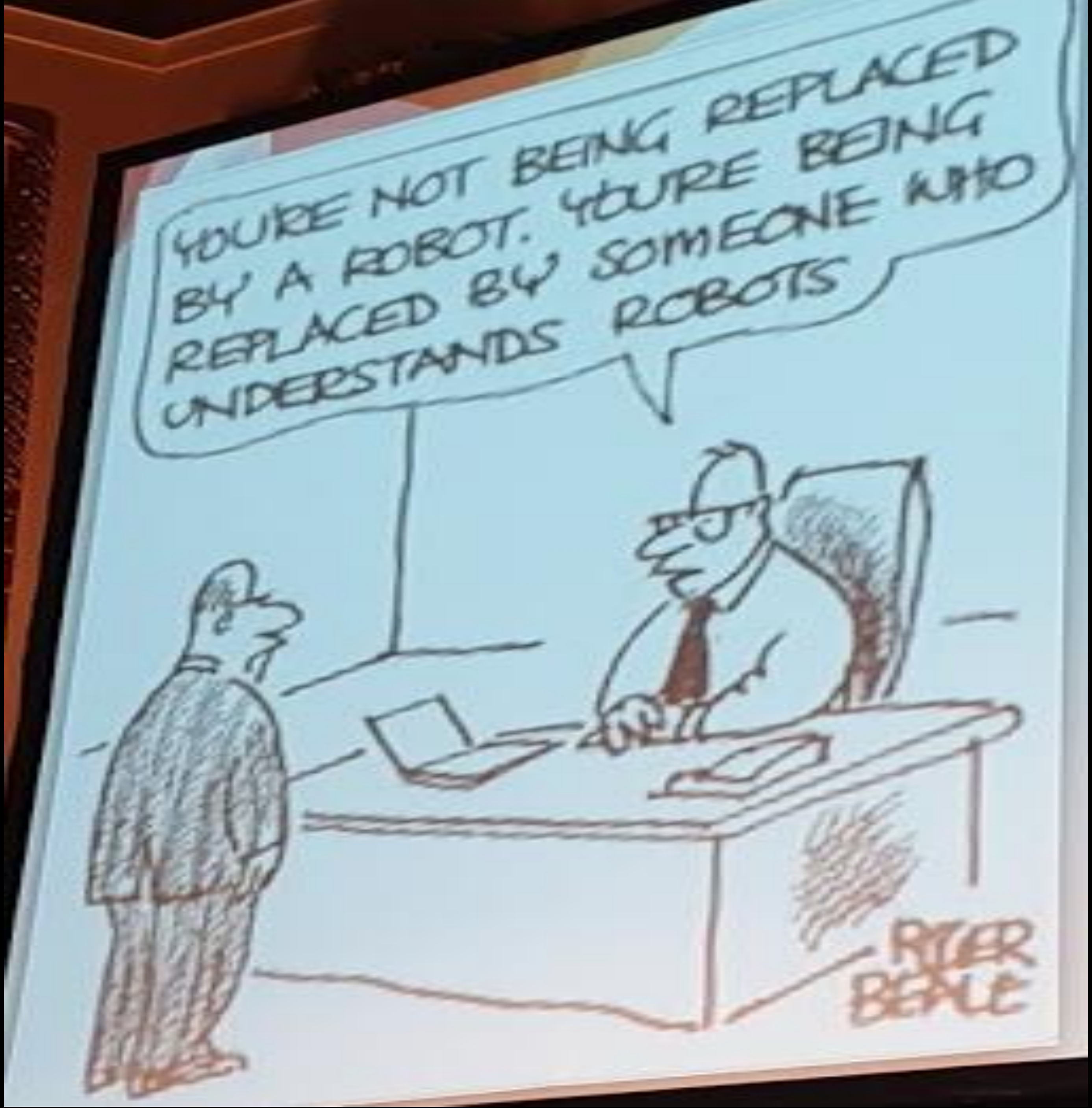
YOU'RE NOT BEING REPLACED BY A ROBOT. YOU'RE BEING REPLACED BY SOMEONE WHO UNDERSTANDS ROBOTS
RYER BEALE

Mundane tasks

- Results sign off
- Ordering
- Notes
- Task communication