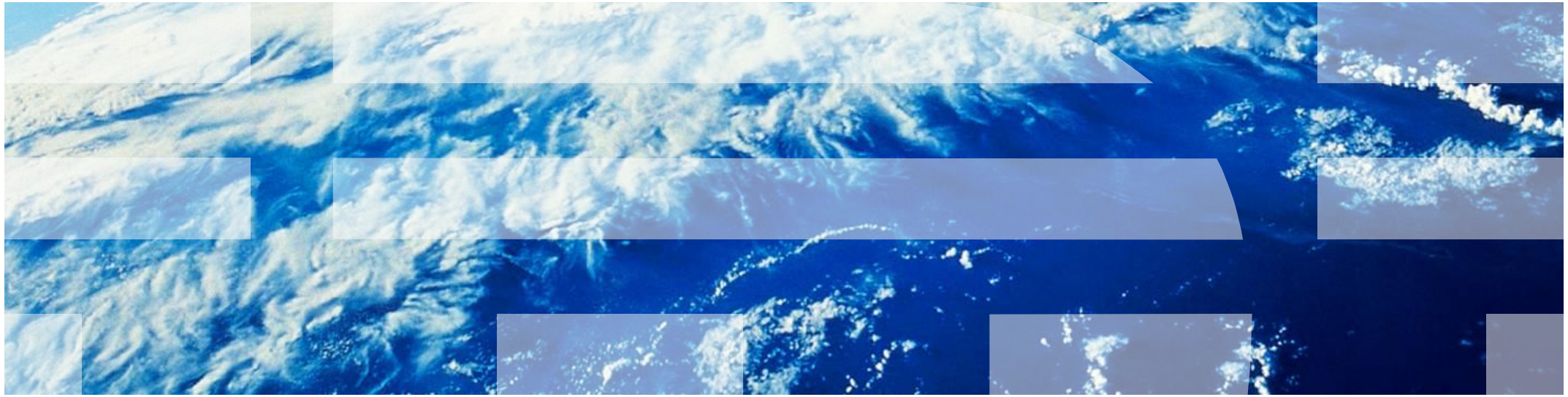
Dr Boudewijn de Bliek
Executive Partner, IBM Global Business Services
Mail: boudewijn_debliek@be.ibm.com

Cognitive Computing in Healthcare

June 2017



Topics

- Watson and Cognitive computing
- Watson for Oncology, Genomics, Clinical Trails
- Radiology

May 11th, 1997

Computer won world champion of chess

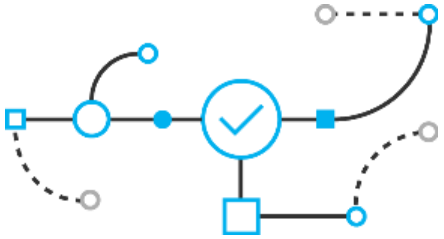
(Deep Blue) (Garry Kasparov)


THINK
$24,000
Who is Stoker?
(I FOR ONE WELCOME OUR NEW COMPUTER OVERLORDS)
$1,000
$77,147
Who is Bram Stoker?
$ 17,973
$21,600
WHO IS BRAM STOKER?
$5600

There are three capabilities that differentiate cognitive systems from traditional programmed computing systems.

Understanding

Cognitive systems understand like humans do, whether that's through natural language or the written word; vocal or visual.



Reasoning

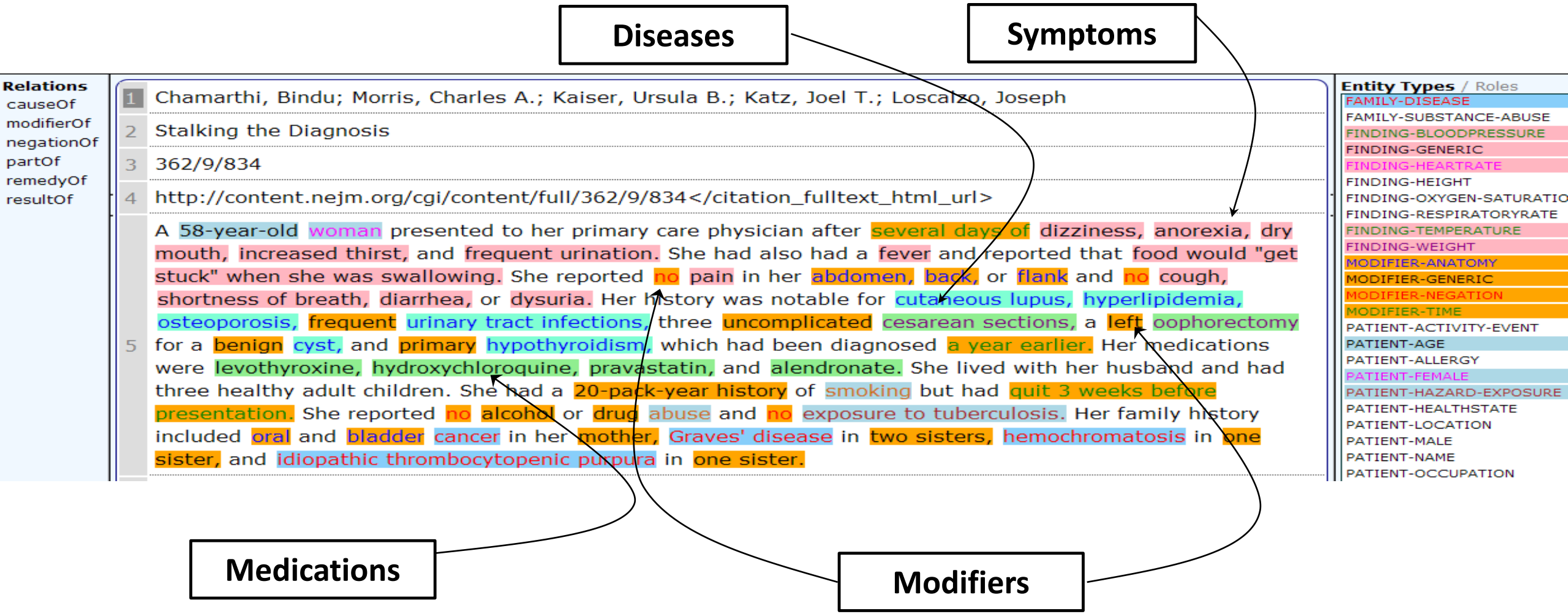
They reason. They can understand information but also the underlying ideas and concepts. This reasoning ability can become more advanced over time. It's the difference between the reasoning strategies we used as children to solve mathematical problems, and then the strategies we developed when we got into advanced math like geometry, algebra and calculus.

Learning

They never stop learning. As a technology, this means the system actually gets more valuable with time. They develop "expertise". Think about what it means to be an expert- - it's not about executing a mathematical model. We don't consider our doctors to be experts in their fields because they answer every question correctly. We expect them to be able to reason and be transparent about their reasoning, and expose the rationale for why they came to a conclusion.

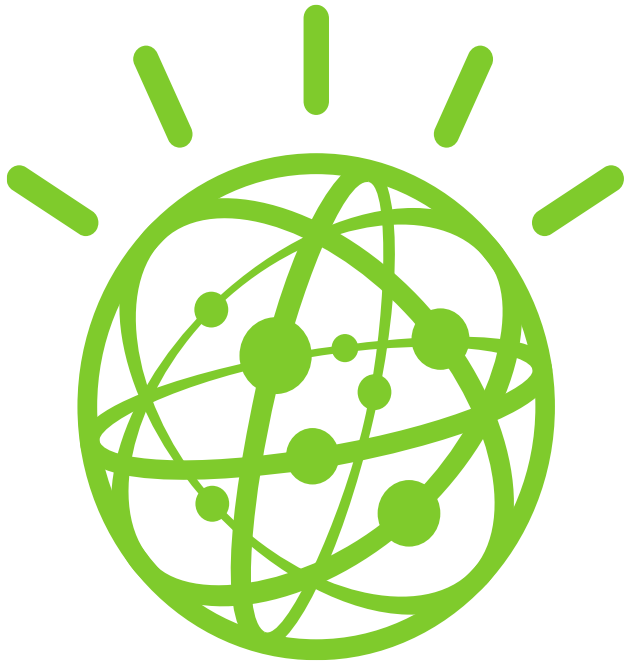
IBM

Natural Language Processing In Healthcare



Watson reads medical journals and literature as source of knowledge.

The big picture in oncology



Oncology

Genomics

Clinical Trials

Memorial Sloan Kettering Cancer Center

Bumrungrad International HOSPITAL

Manipal Hospitals LIFE'S ON

Best Doctors

NEW YORK GENOME CENTER

U.S. Department of Veterans Affairs

MAYO CLINIC

Froedtert & Medical College of Wisconsin

Watson for Oncology: Evidence-Based, Personalized Treatment Plans

Cloud Based

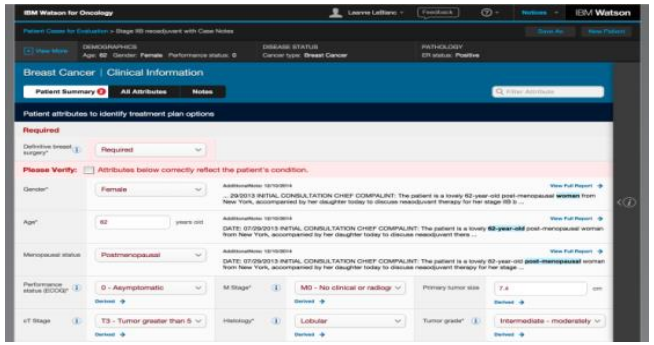
- SAAS Cloud Based Solution
- Triple redundancy
- Speed

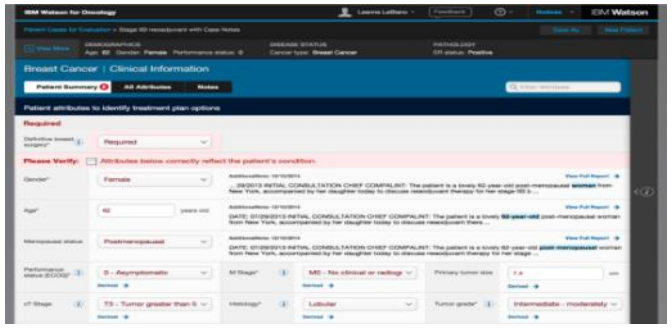
Expansion

- Second and Third line treatment options
- New cancers

Localization

- Clinical Attributes
- Drug Formularies & Dosing
- Supporting Guidelines & Evidence
- Other Local Considerations





Corpus

The Corpus contains Health line Medical Taxonomy to varied sources from:
ASCO, EBSCO information services, Elsevier, MMS, NCCN guidelines, US Government, Wiley

- 250 textbooks
- 200 medical journals
- 15 million pages of Oncology text
- >10,000 oncology cases

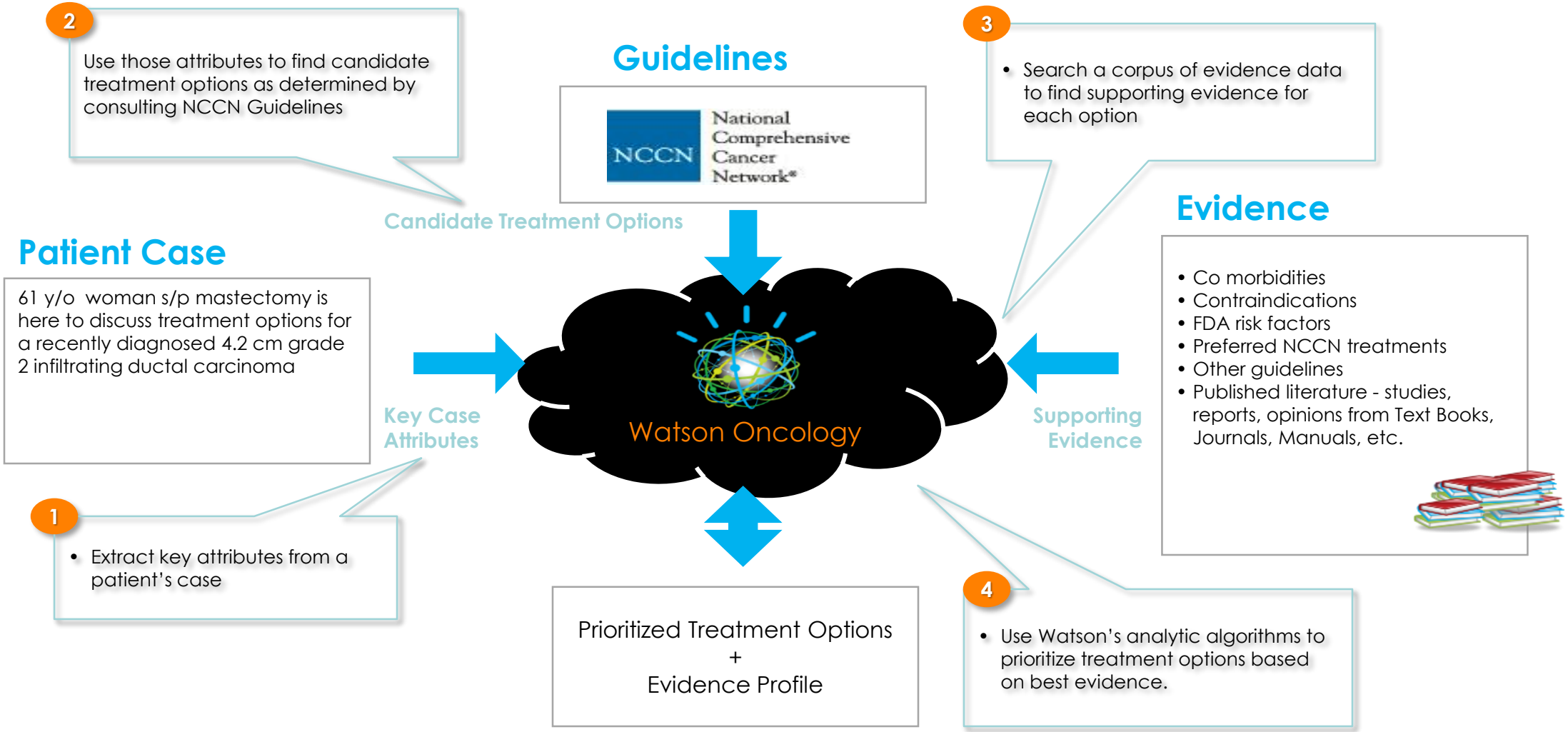
Training

Refresh

- Continuous training by MSKCC oncologists
- Refresh and Maintenance of corpus
- New cases

Memorial Sloan Kettering Cancer Center

Watson for Oncology: From Patient Case to Treatment Options in 4 steps



View more

DEMOGRAPHICS
Age: **62** Gender: **Female**

DISEASE STATUS
Cancer type: **Breast cancer** Cancer stage: **IIB**

TREATMENT HISTORY
Surgery: **Not specified** Chemotherapy: **Not specified**

Treatment Plan Options for: Stage IIB neoadjuvant with Case Notes

Select a clinical trial

Chemotherapy followed by surgery followed by endocrine therapy and radiation therapy

More treatment plan options

Chemotherapy followed by surgery followed by endocrine therapy and radiation therapy

Save treatment plan options

Timeline for Treatment Plan (shown in years)

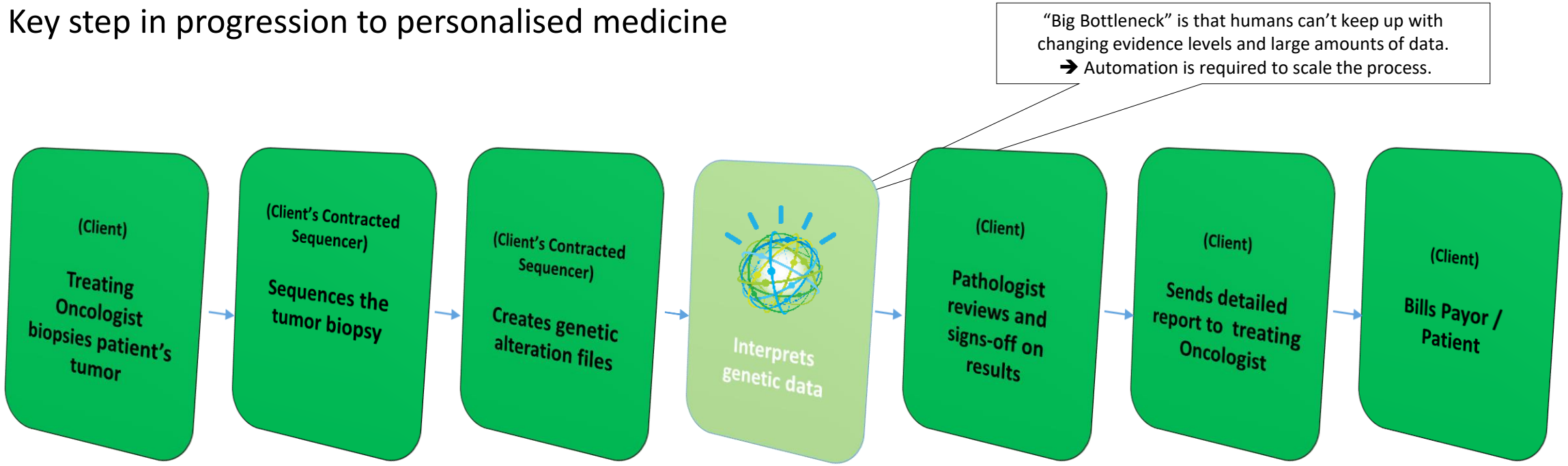
Chemotherapy	Surgery	Endocrine	Radiation
Dose-dense AC (Doxorubicin / Cyclophosphamide) followed by T (Paclitaxel)	Referral to surgery	Letrozole at least 5 years Anastrozole at least 5 years	Referral to radiation oncology
FEC (Fluorouracil / Epirubicin / Cyclophosphamide) followed by Docetaxel TAC (Docetaxel / Doxorubicin / Cyclophosphamide)		Tamoxifen	

Watson for Genomics

As the cost of Next Generation Sequencing decreases, there will be an increase in tumor genome sequencing resulting in massive quantities of genetic data to analyze.

It is extremely complex and labor-intensive (can take from days to weeks) to Identify the genetic alterations driving the cancer and matching them with molecular targeted therapies.

Key step in progression to personalised medicine

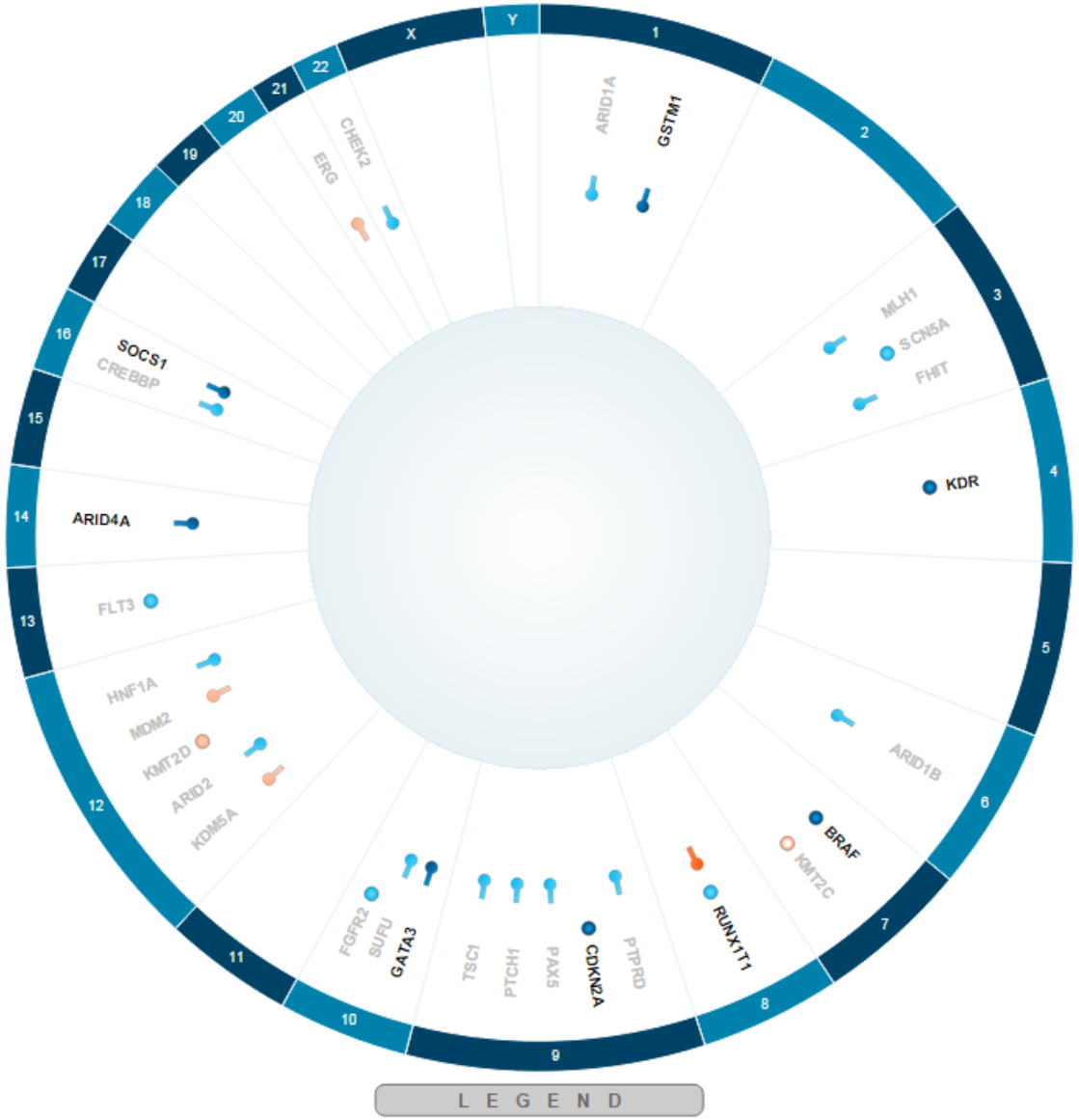


Watson Genomics - Functionality Highlights

- Cloud based solution, multi-user and multi-tenant solution with a single code base
- No customization, configuration or integration required
- Security safeguards implemented and managed by IBM and industry standards
- All patient data uploaded to WfG is de-identified (de-identified mutated DNA)
  - Accepted input data includes somatic mutations, copy number variations and gene expression
  - Supports gene panels, whole exome and whole genome sequenced files
  - Natural Language Processing (NLP) used to extract information from extensive medical literature (over 23 millions articles)
  - 20+ structures and unstructured data sources ingested
- Analytics engine to identify relevant alterations, drugs and clinical trials for all types of cancer
- Pharmacogenomic rules implemented
- Report and interactive visualizations of the molecular profile, drugs and pathways
- Summary report shows target therapeutic options categorized by FDA approved, Investigational and Off Label
- Evidences presented via hyperlinks to sources for easy drill down

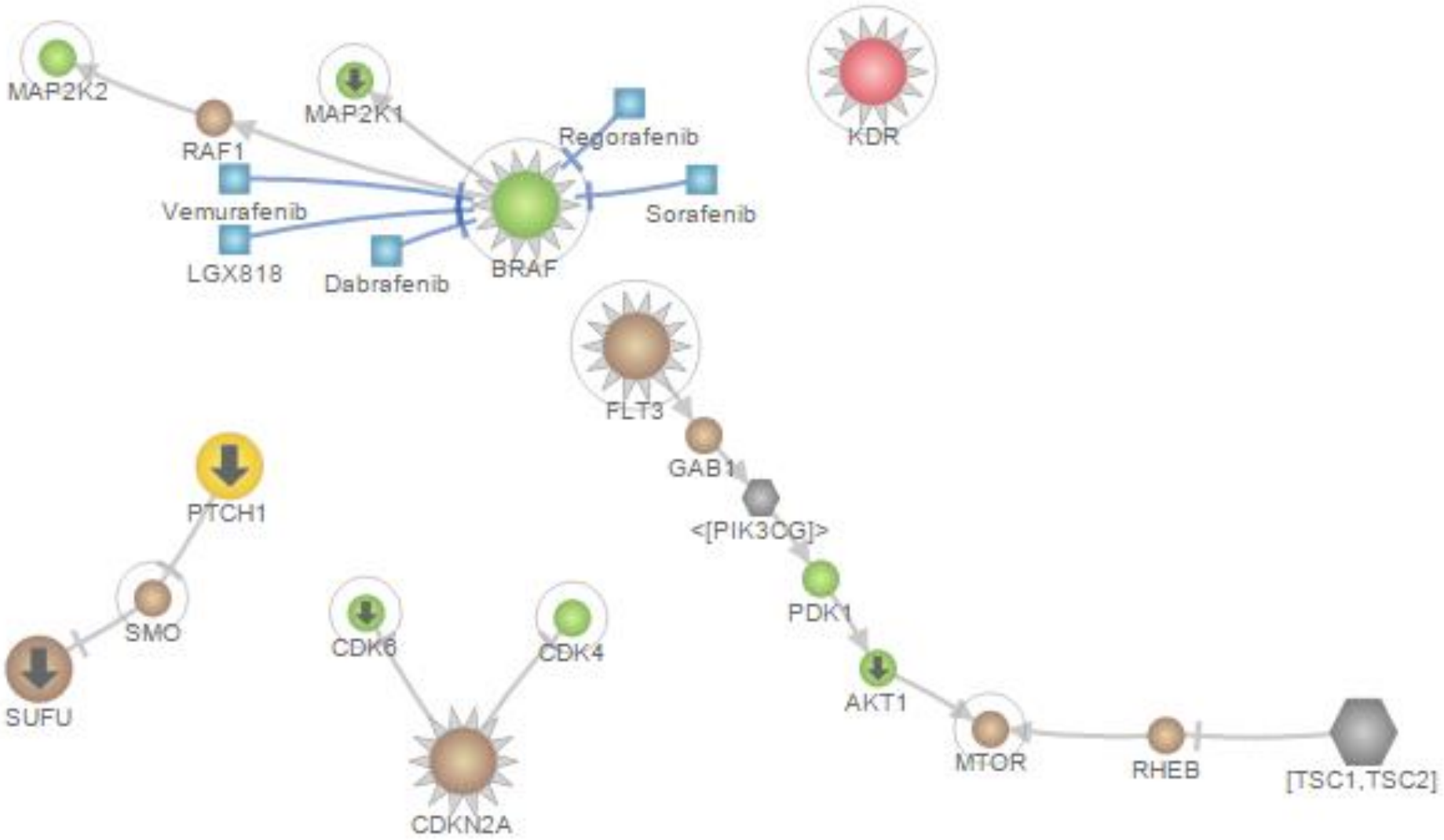
Watson for Genomics: Molecular Profile analysis

Summary | **Molecular Profile** | Pathway | Drugs



Select	Relevance		Alteration	
☐	▮▮▮	BRAF	*V600E*	+
☐	▮▮▮	RUNX1T1	*Amplification* *L196F*	+
☐	▮▮▮	GSTM1	*Loss*	+
☐	▮▮▮	GATA3	*Loss*	+
☐	▮▮▮	SOCS1	*Loss*	+
☐	▮▮▮	CDKN2A	*H83D*	+
☐	▮▮▮	KDR	*R1032Q*	+
☐	▮▮▮	ARID4A	*Loss*	+
☐	▮▮▮	ERG	*Amplification*	+
☐	▮▮▮	MDM2	*Amplification*	+
☐	▮▮▮	FHIT	*Loss*	+
☐	▮▮▮	PTCH1	*Loss*	+
☐	▮▮▮	KMT2D	*E1186**	+
☐	▮▮▮	PAX5	*Loss*	+
☐	▮▮▮	ARID2	*Loss*	+
☐	▮▮▮	PTPRD	*Loss*	+

Watson for Genomics: Pathway analysis



Watson for Genomics: Drug Analysis

Approved for NSCLC

- Afatanib
  EGF
  Level 1
- Erlotinib
  EG
  Level 1

Investigational for NSCLC

- BMS-690514
  EGFR
  Level 3
- BAY846
  EGFR
  Level 3

Off Label

Overview | Literature | Clinical Trials

Afatinib

Target:
EGFR

Relationship to Driver Gene
is Driver Gene

Description
Approved for first line treatment of metastatic NSCLC with EGFR exon 19 deletions and exon 21 L858R alterations.

Drug Sensitivity

EGFR exon 19 deletions
Summary Blurb
Evidence

EGFR exon 21 L858R substitutions
Summary Blurb
Evidence

Drug Resistance

EGFR T790M
Summary Blurb
Evidence

Mechanism of action

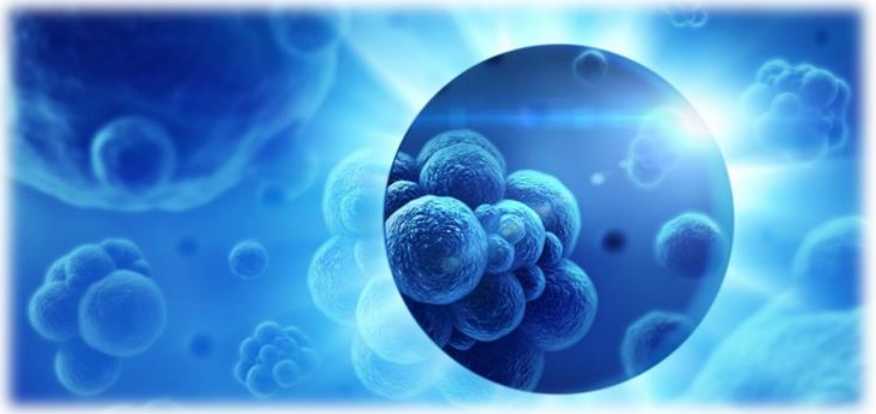
Afotinib demonstrated inhibition of outophosphorylotion and in vitro proliferation of cell lines expressing wild· type EGFR or those expressing selected EGFR exon 19 deletion mutations or exon 21 L858R mutations, including some with o secondary T790M mutation, at ofotinib concentrations achieved , at least transiently, in patients. In addition, ofotinib inhibited in vitro proliferation of cell lines overexpressing HER2.

Treatment with ofotinib resulted in inhibition of tumor growth in nude mice implanted with tumors either overexpressing wild type EGFR or HER2 or in on EGFR L858R/T790M double mutant

Watson Clinical Trials Matching

Overall only 3% of cancer patients are on clinical trials

IBM Watson Clinical Trial Matching



Business problem:

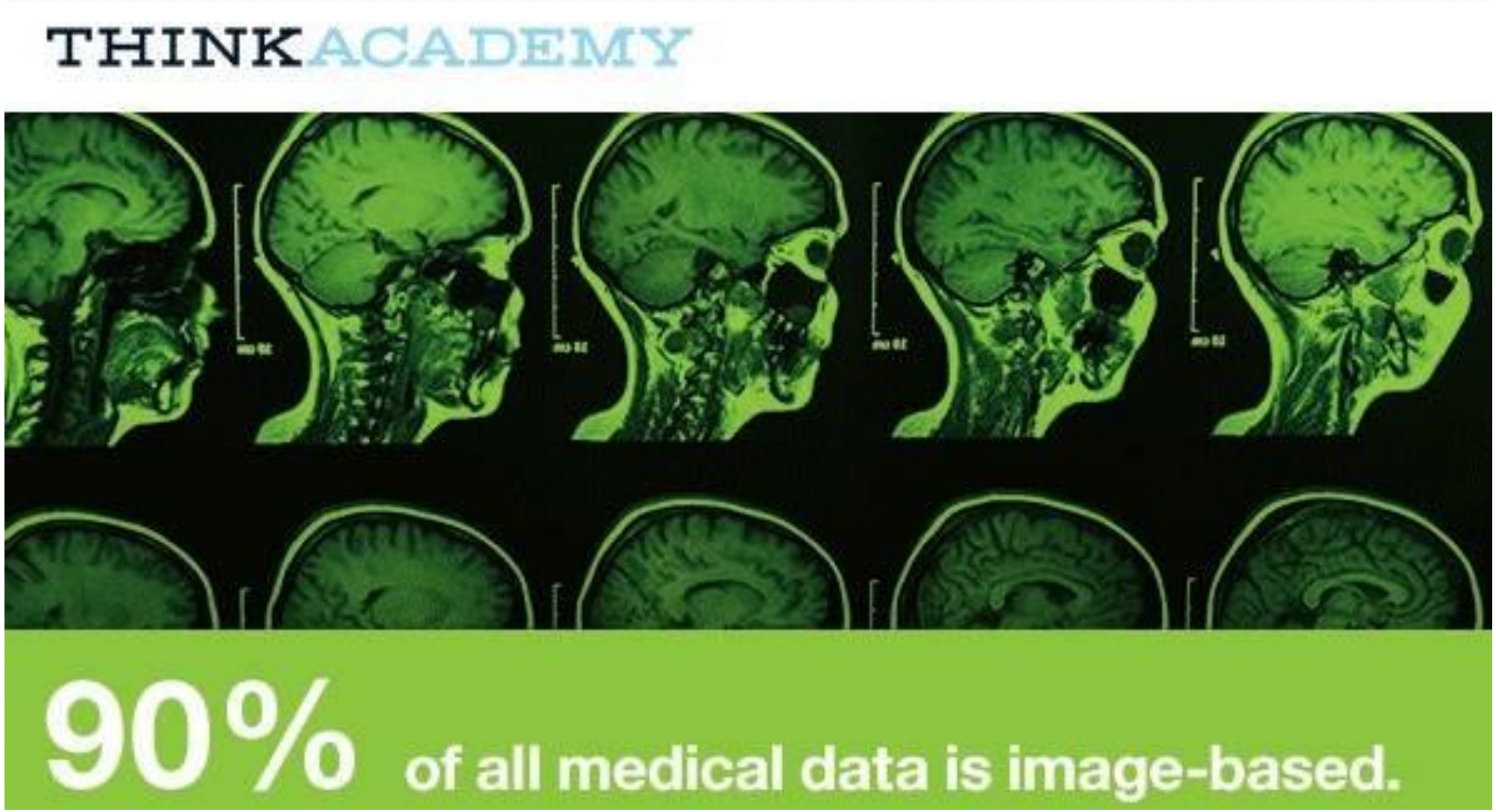
- No easy way to search eligibility criteria at point of care to match patients to clinical trials

Solution:

- Identify all the relevant clinical attributes needed to search across clinical trials for a disease
- Instantly check the patient's eligibility
- Provide an ordered list of relevant clinical trials with the degree of match
- Provide criteria (inclusion / exclusion) level evaluation based on the patient's attributes
- Dynamically re-evaluate the case based on changes to clinical attributes

[1] Medscape

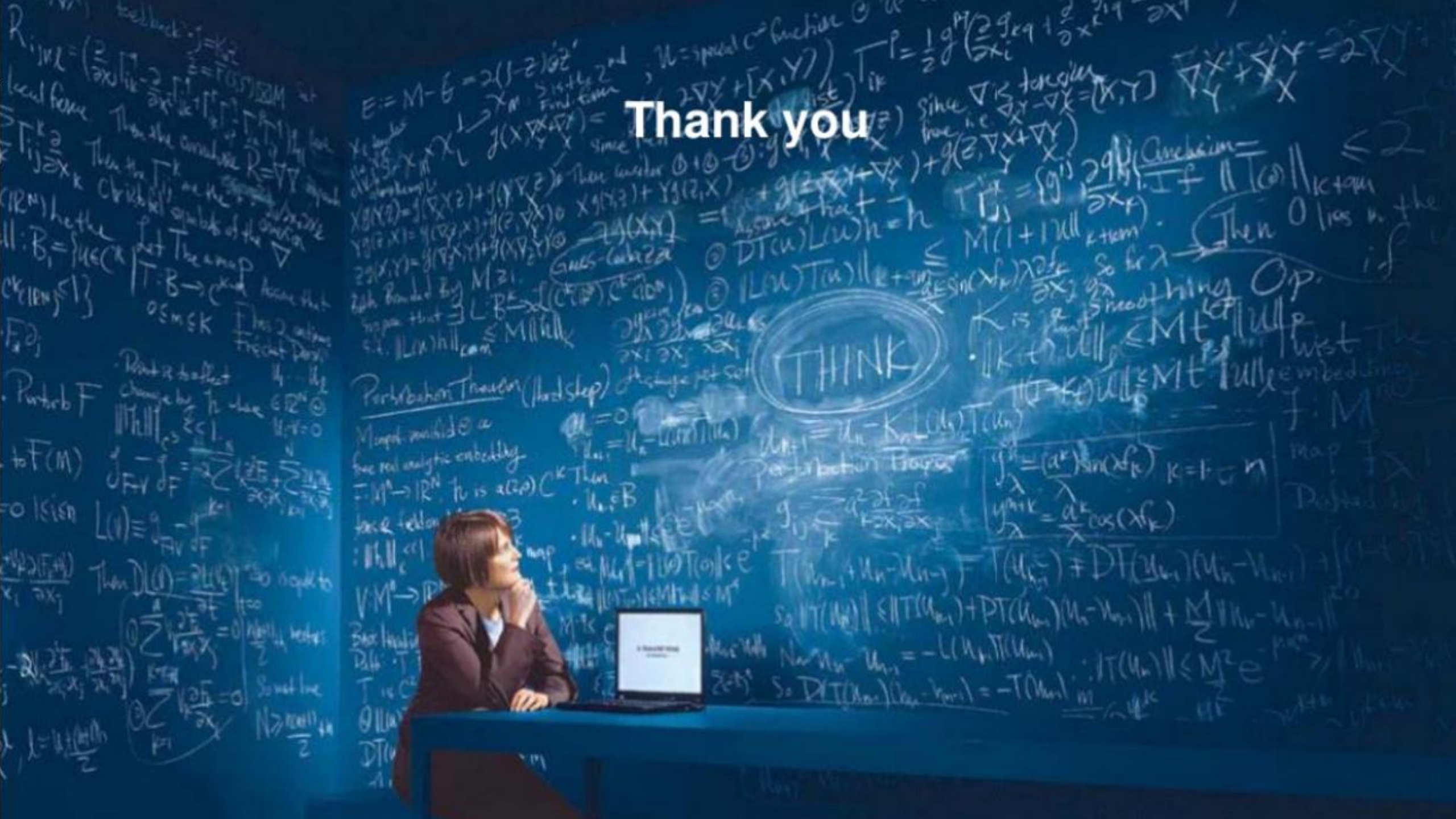
Vision – Teaching Watson to See



Radiology Cognitive Assistant

- Cognitive applied to medical imaging may become the most disruptive technology Radiology has seen since the advent of digital imaging
- X-ray's, MRI's, CT-scans, Angiograms and many other medical images
- Radiology Challenges: Increasing volumes of images and limited amount of clinical information
  - Statistics show that eye fatigue is a common problem with radiologists
  - An emergency room radiologist may see as many as 200 cases a day, and some of these imaging studies (eg lower body CT angiography) can be 3000+ images per study.
  - Due to the volume overload, and limited amount of clinical information available as part of imaging studies, diagnosis errors can occur.
- "Grand challenge" research project in IBM Research
- IBM Watson project code name: Avicenna

You, *with* IBM.


Thank you
THINK