

Healthcare technologies to improve Efficiency

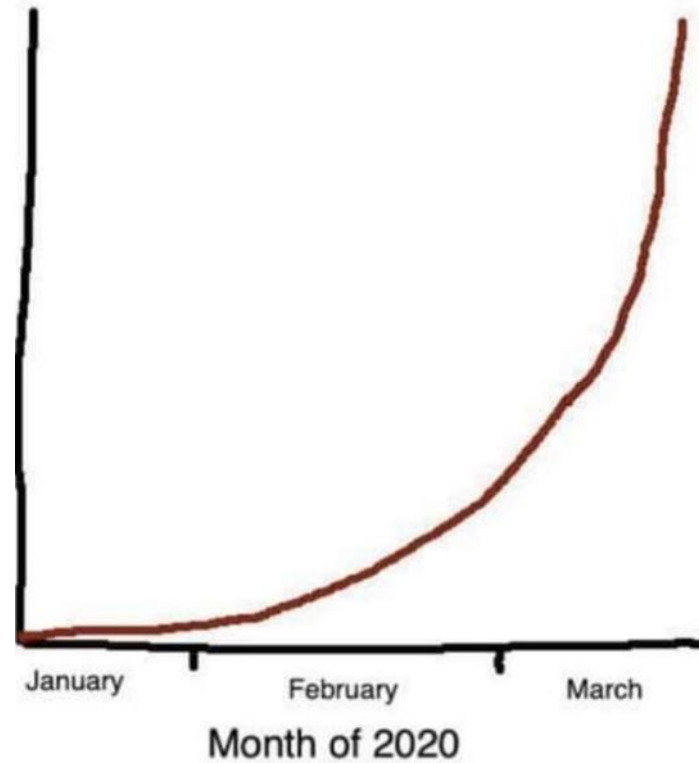
Prof James Teo

Clinical Director of Data & AI
Professor of Neurology

Kings College Hospital
Guys & St Thomas Hospital

Time spent
looking at
exponential
graphs

Amount of
medical data



PROBLEMS

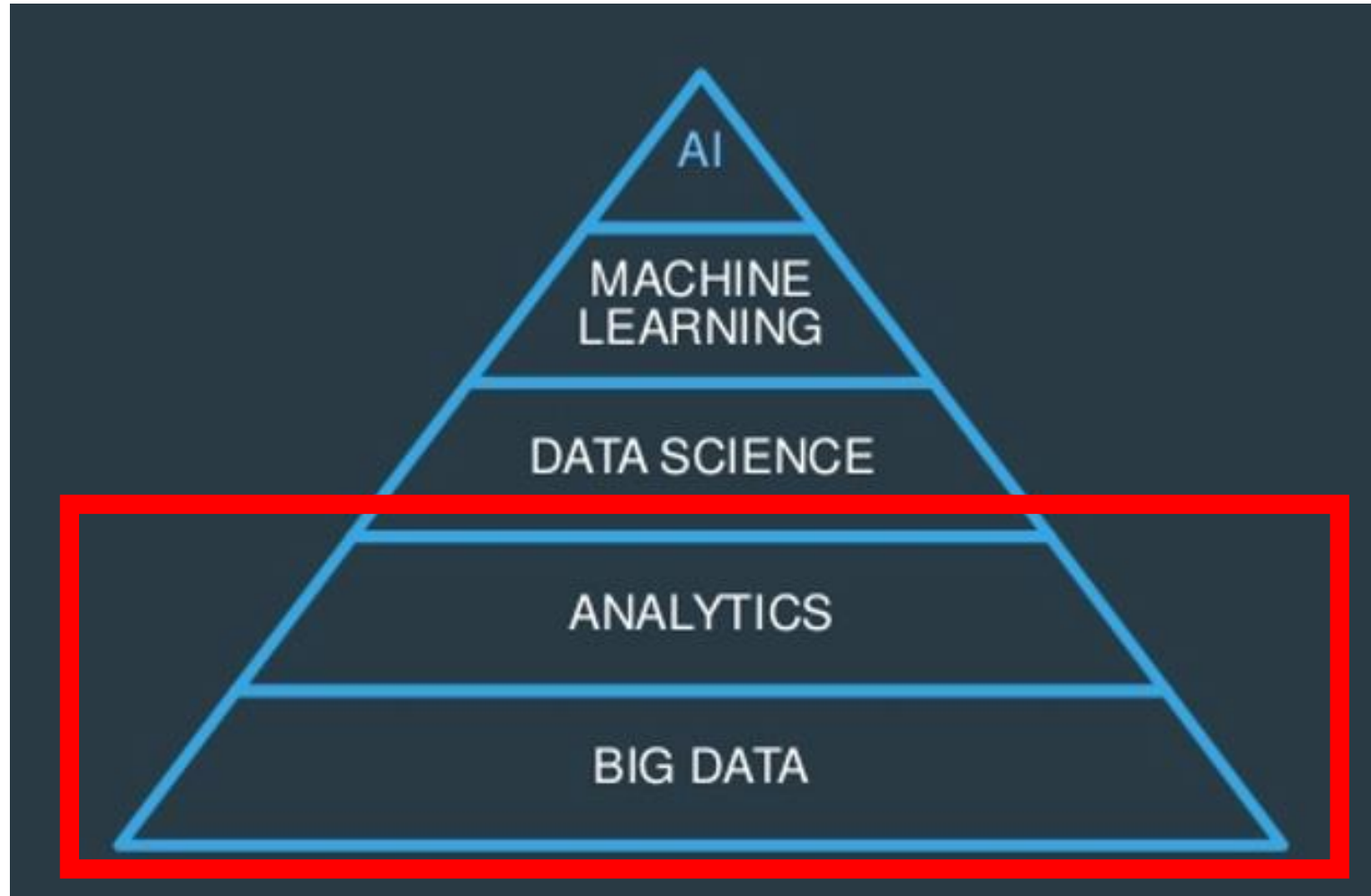
Too much health data

Health data is all over the place

Health data is not standardised

Data is stored inflexibly

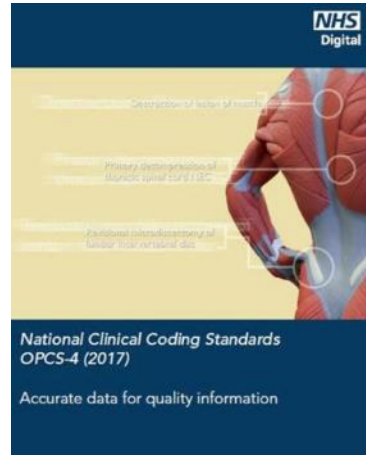
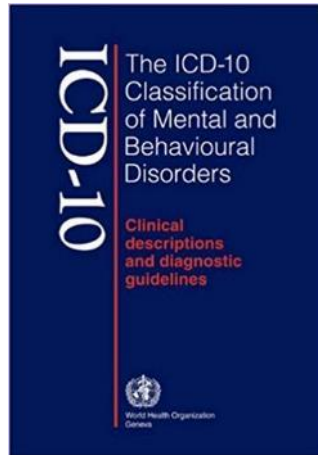
HIERARCHY OF NEEDS



What We Want

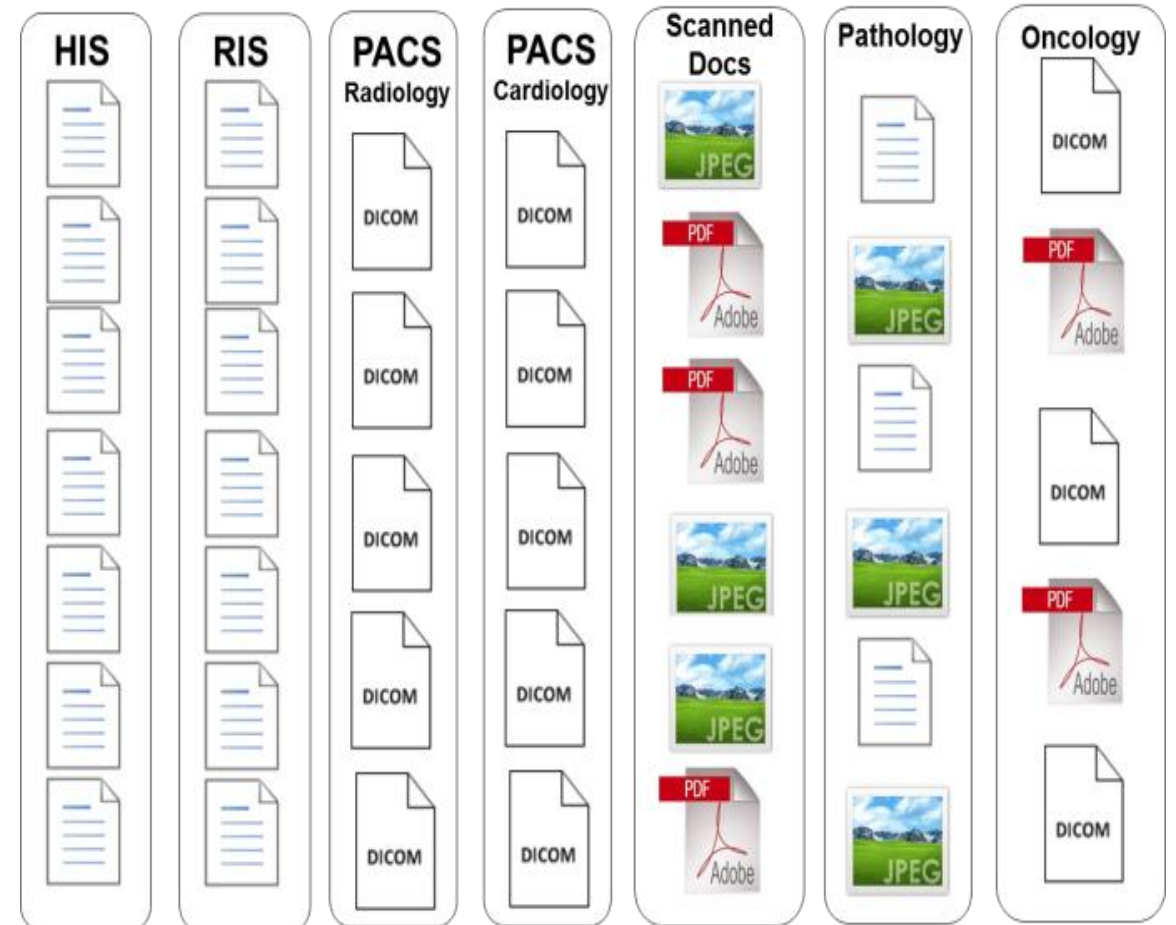
Structured Data

	Date	Time	Target Temp	Actual Temp	SystemID	SystemAge	BuildingID
1	6/4/13	4:13:19	65	64	1	11	14
2	6/5/13	5:13:19	66	66	17	30	16
3	6/6/13	6:13:19	68	70	8	27	10
4	6/7/13	7:13:19	70	70	13	25	4
5	6/8/13	8:13:19	65	62	11	29	12
6	6/9/13	9:13:19	67	65	16	12	16
7	6/10/13	10:13:19	66	64	11	19	13

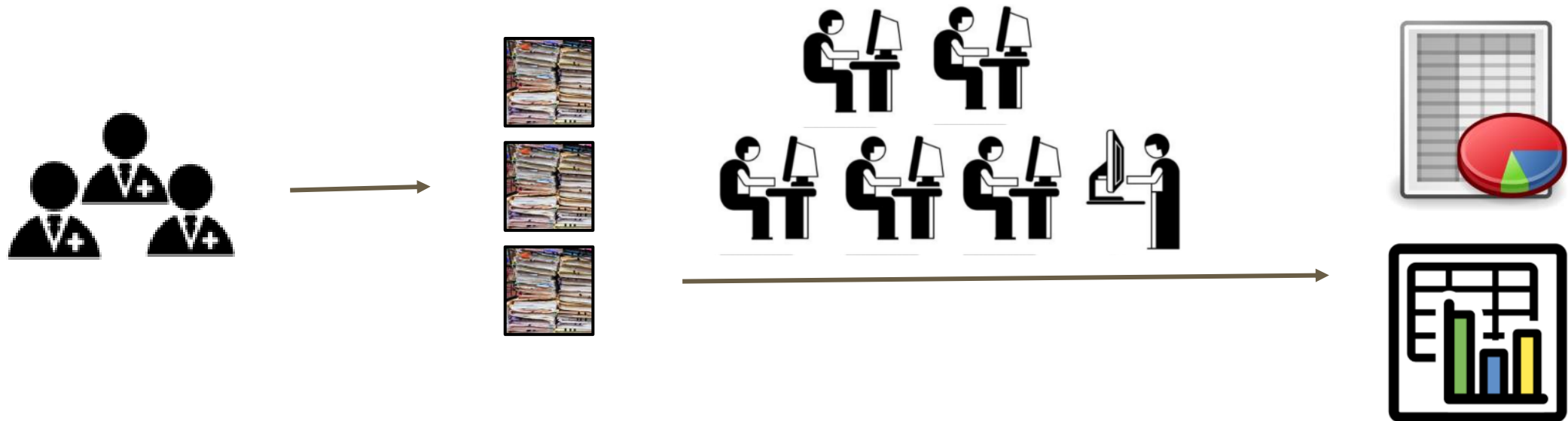


What We Have

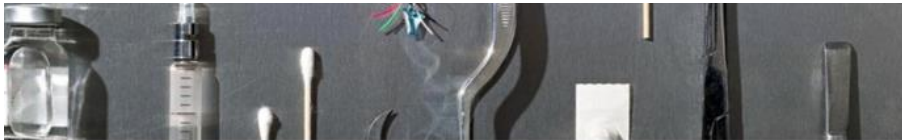
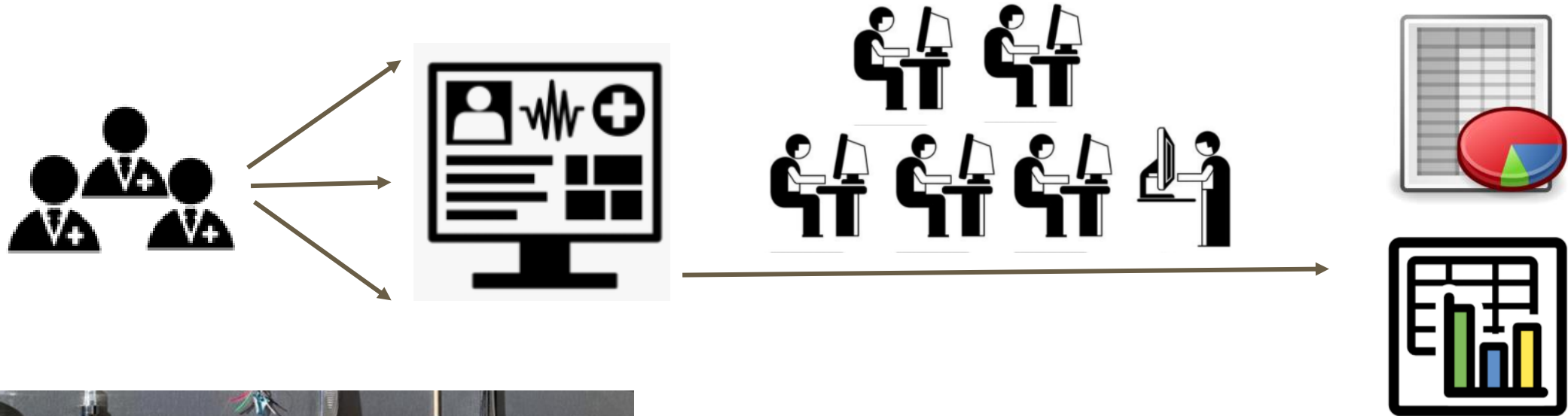
Unstructured Data



The original way of producing and cleaning data



Add a new Electronic Health Record System?



Death by a Thousand Clicks: Where Electronic Health Records Went Wrong

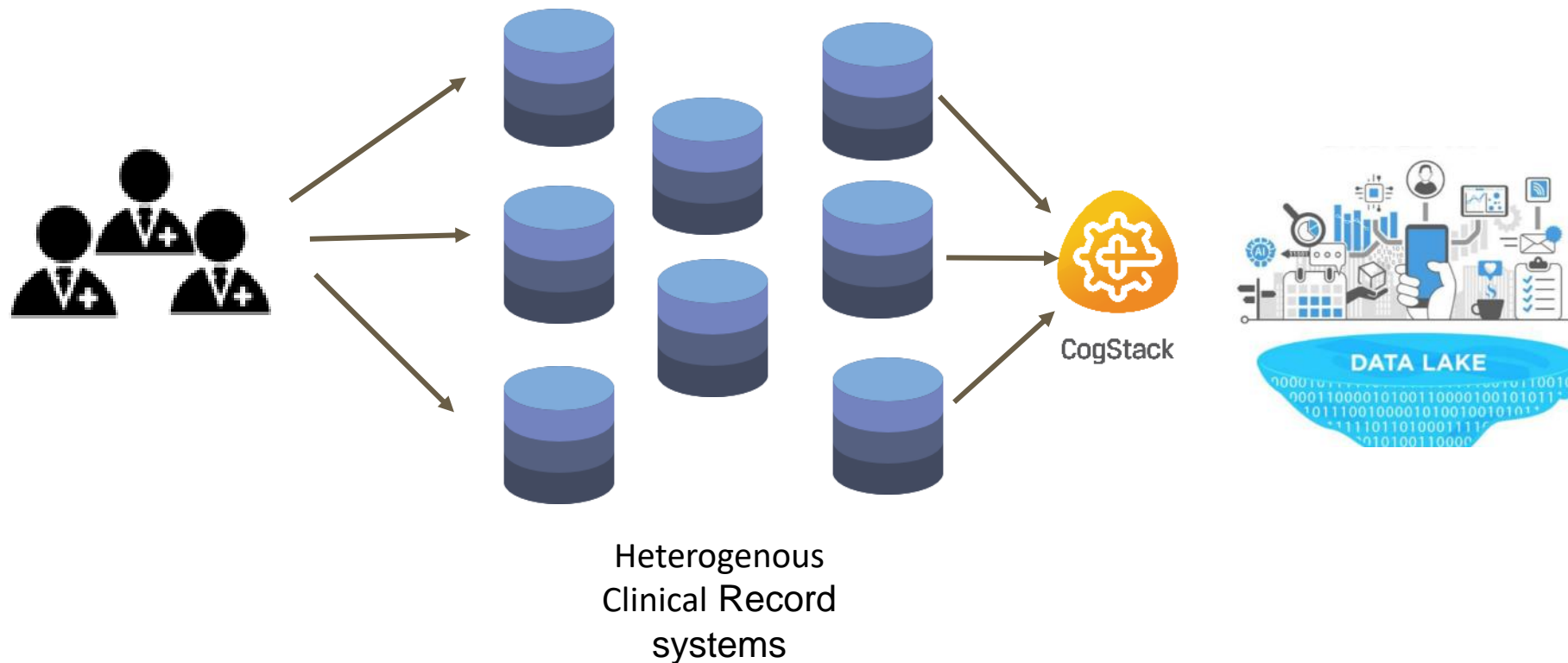
The U.S. government claimed that turning American medical charts into electronic records would make health care better, safer, and cheaper. Ten years and \$36 billion later, the system is an unholy mess: Inside a digital revolution gone wrong. A joint investigation by Fortune and Kaiser Health News.

The Journey of Kings and Guys & St Thomas



Software | [Open Access](#) | [Published: 25 June 2018](#)

CogStack - experiences of deploying integrated information retrieval and extraction services in a large National Health Service Foundation Trust hospital

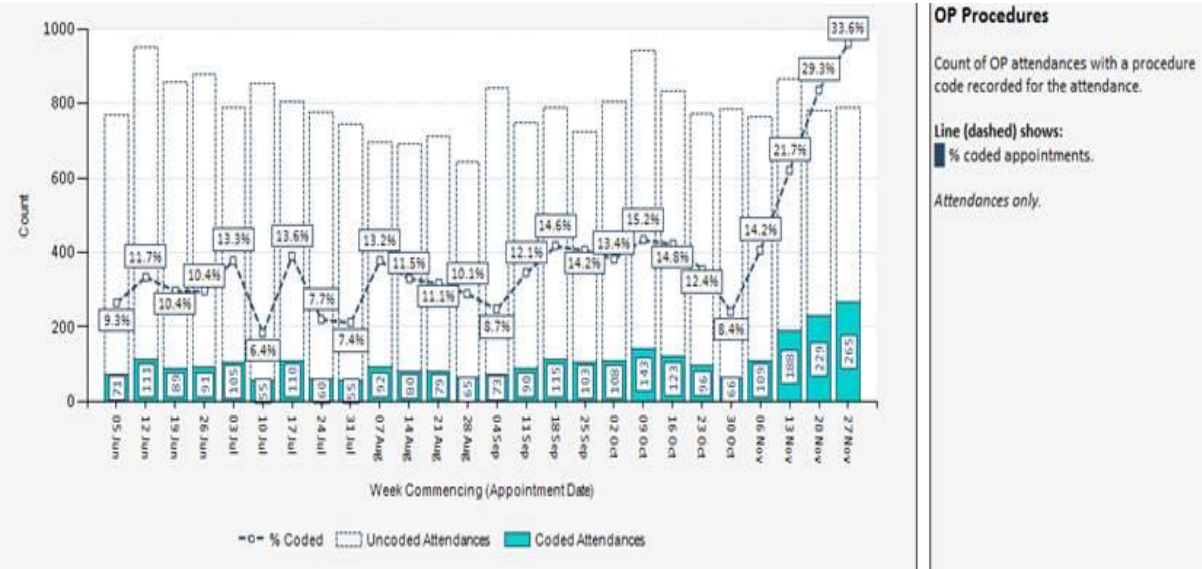
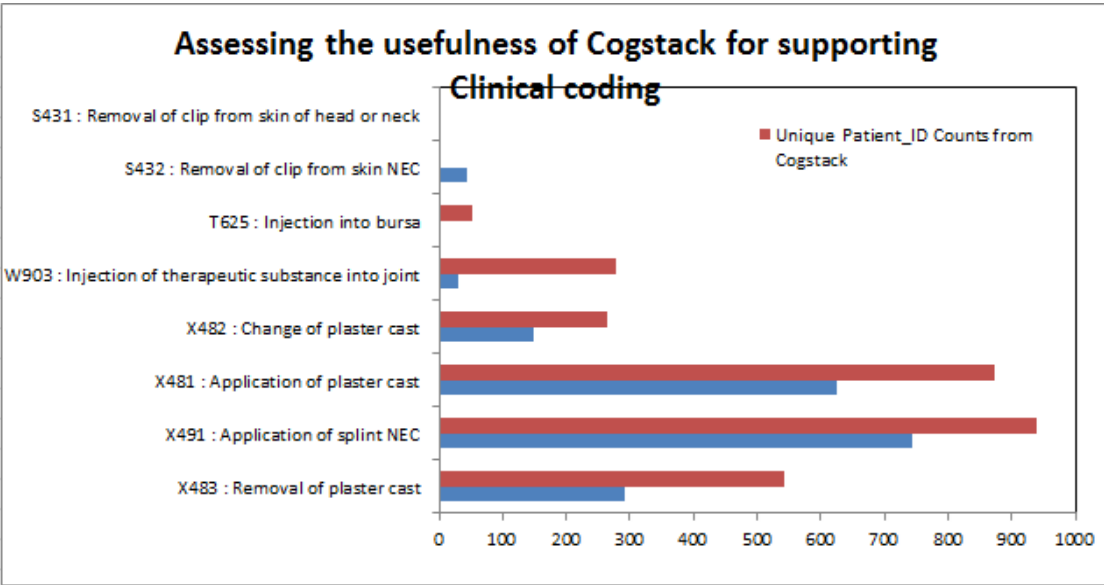


Scoping the level of under-coding found in unstructured text

Mismatch of patients having OPD procedures documented in letters (RED) versus what is coded on appointment systems (BLUE)

XX in plaster room and **cast** him for an AFO. Our orthopaedic technician **applied** a further **cast** to correct adduction-varus in plantargrade and **applied** a below knee **cast**. His AFO should be ready in X-3 weeks. We have arranged to see XXXX in X weeks and may consider a further manipulation and cast should dynamic varus and adductus warrant further correction. However, I am mindful of the fact that XXXX has been in a **cast** since March and will discuss this further with the patient.

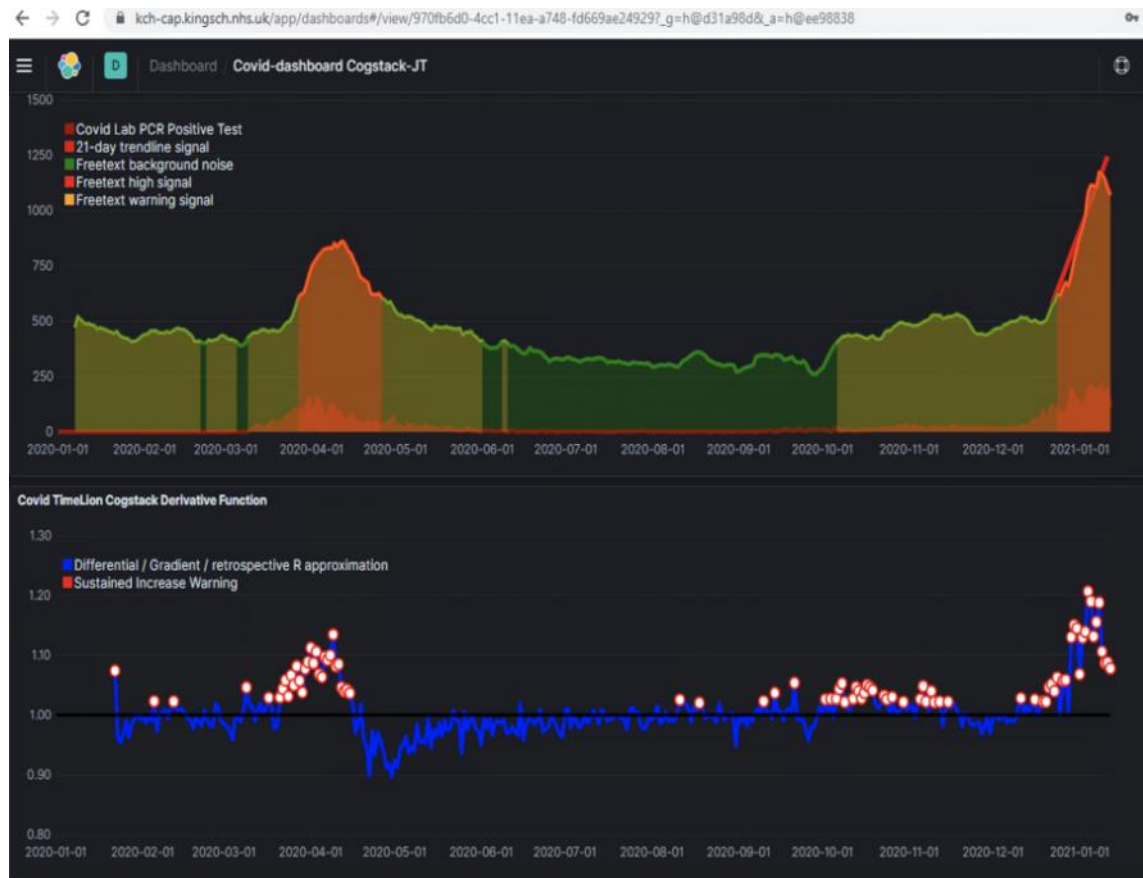
2x increase in coding in just 3 weeks



Streaming unstructured data feeds of the hospital

KCH (900 beds)

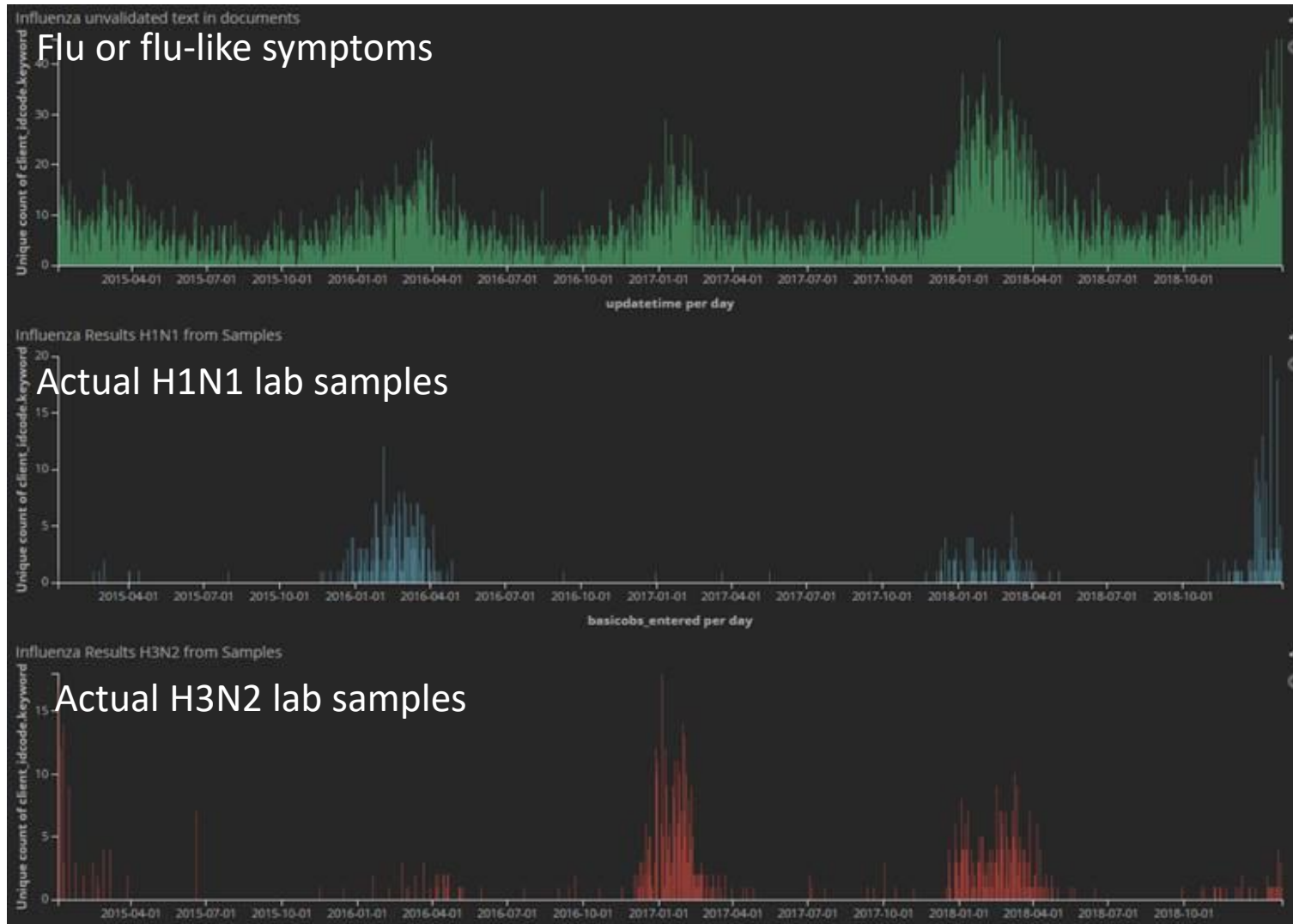
PRUH (600 beds)



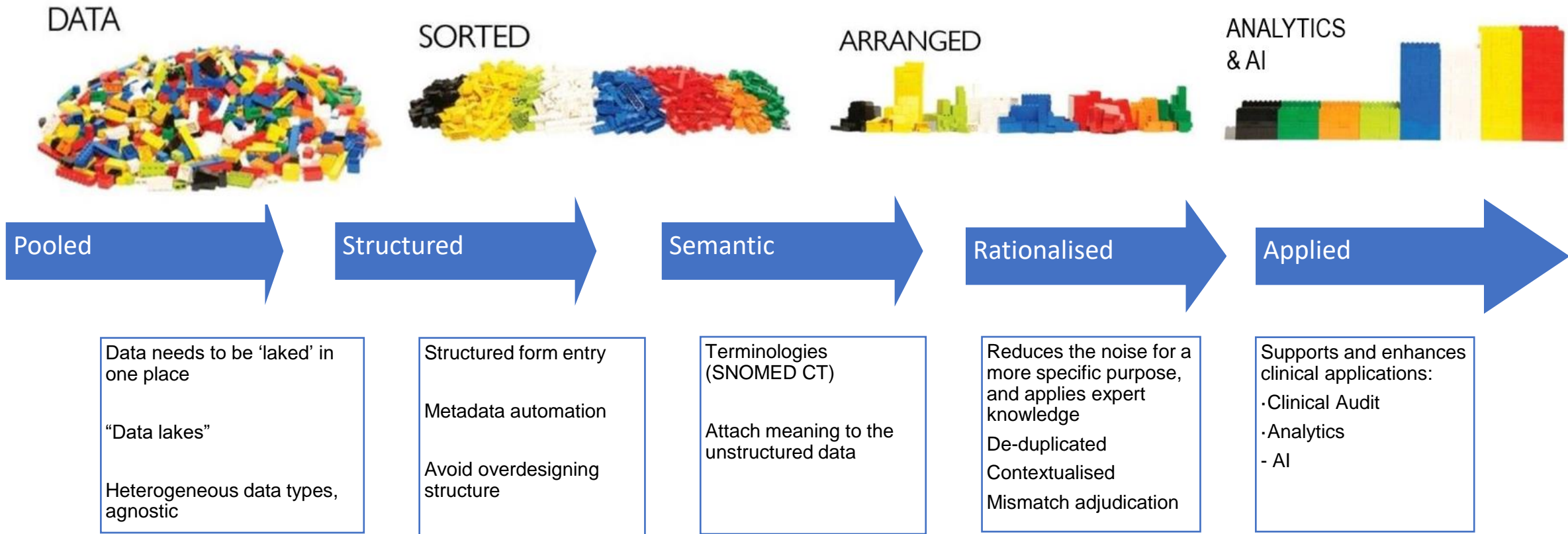
Guys & St Thomas (850 beds)



Real-time Data feed of flu or flu-like illness



Human-lite Data Processing Pipeline



Natural Language Processing

- Designed for free-form digital text
- Language AI for common languages already very mature
- Clinical language NLP is in rapid development and past proof-of-concept phase



CogStack



AI-based language
processing

Documentation (Wiki):

<https://cogstack.atlassian.net/wiki/spaces/COGDOC/overview>

Slack:

cogstack-dev.slack.com

GitHub:

<https://github.com/CogStack/>

NHS^x

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Cogstack

24 August 2020

Design and build AI

Cogstack is an open source real-time data warehousing tool meeting the need for an efficient way of coding that improves financial and operational efficiencies for NHS providers.

Case study

King's College Hospital NHS Foundation Trust, together with the South London and Maudsley Hospital, have developed an opensource real-time data warehousing tool called 'Cogstack' that improves operational efficiency significantly.

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(PDF, 105.2 KB)



Artificial Intelligence in Medicine

Volume 117, July 2021, 102083




Multi-domain clinical natural language processing with MedCAT: The Medical Concept Annotation Toolkit


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Training AI to recognise medical words and sentences

Med AT

(jleo)  [logout](#)

Train Annotations: Drug Names Annotation

Client ID Code XXXXXXXXXX 3978 Remaining 

Clinical Notes

are seeing them tomorrow I think.

Current Medication:

Epilim Chrono 700 mg twice a day

Phenytoin 100 mg twice a day (introduced in October following a recent admission with serial seizures)

Clobazam 5mg am

Topiramate 25 mg twice a day

Clonazepam 1 mg twice a day, currently 1 mg ?? correct dose.

Thyroxine 50 µg/day

Cerazette

Desogestrel 75 µg/day (taken to prevent bleeding not for contraception - I mentioned to her mother that contraceptive effect would be reduced by current enzyme inducing antiepileptic drugs)

Omeprazole (chest pain)



Laxatives, recently discontinued because of a tummy upset

Co-codamol, Paracetamol, Ibuprofen Piriton for recent rash

Oral contraceptive was stopped (contraceptive effect would be reduced by current enzyme inducing antiepileptic drugs)

? contributing to low mood also heavy bleeding occurring ? needs another contraception method.

Her mood is very low, staying in her room / not going out.

Correct

Remove

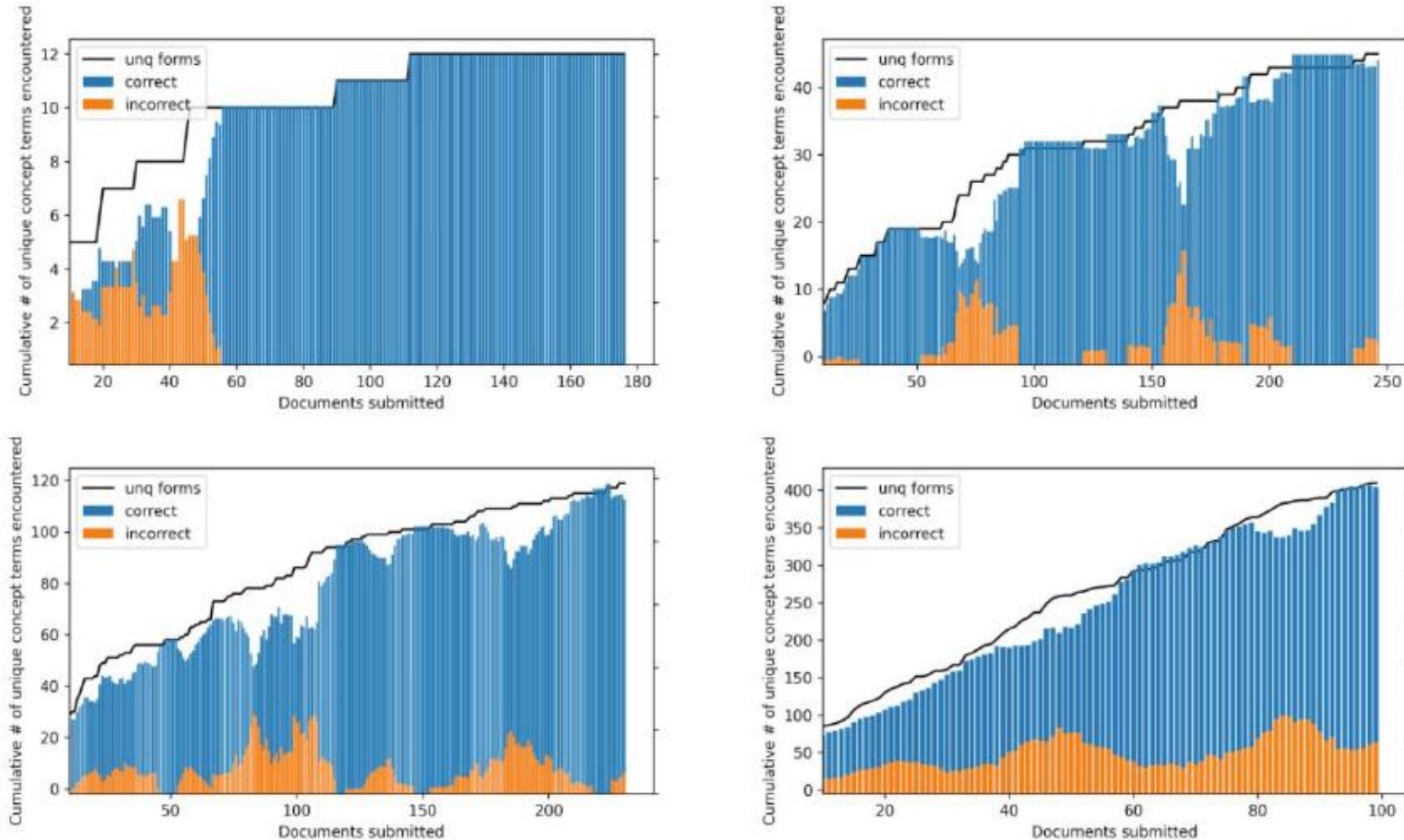
Alternative Concept

Submit

Concept Summary

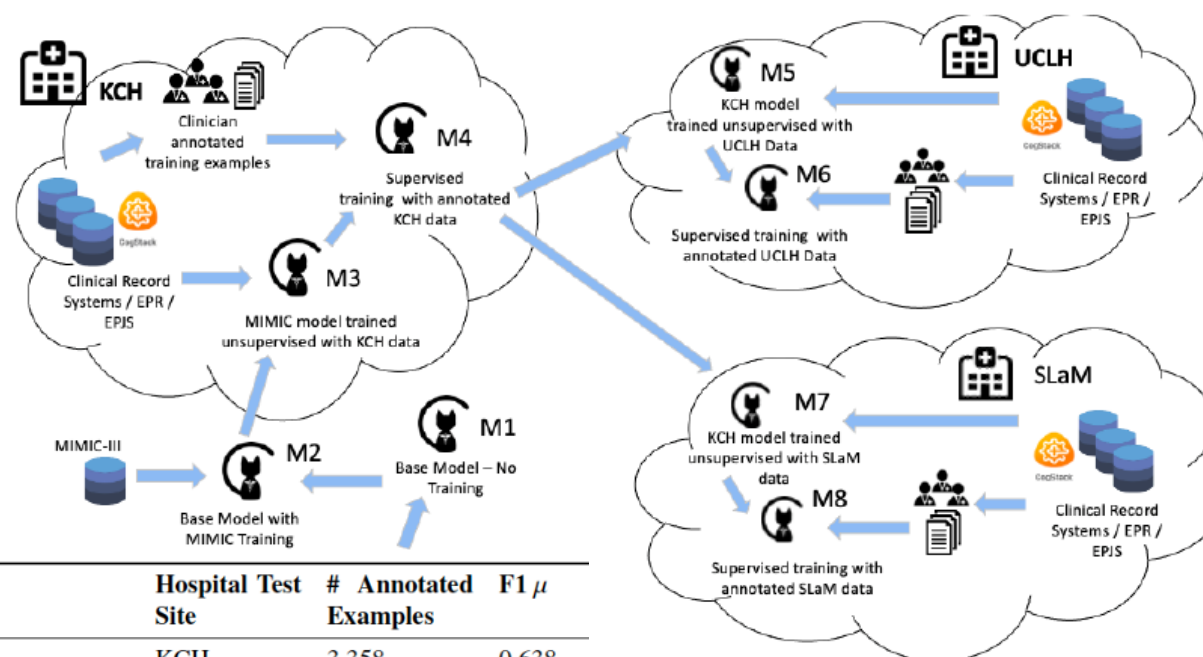
Annotated Text	Oral contraceptive was stopped
Name	contraceptive oral stopping
Term ID	T061
Semantic Type	Therapeutic or Preventive Procedure
Concept ID	C0419515
Accuracy	1.00
Description	n/a

Training and testing AI across many diseases



Top left to bottom right: MedCATtrainer annotation projects with respective numbers unique concepts seen throughout annotating and the number of configured concepts: Covid_COPD (5/12), Covid_Gastro (8/679), Diabetes_Covid (15/864), Covid_CTPA_Reports (194/297280)

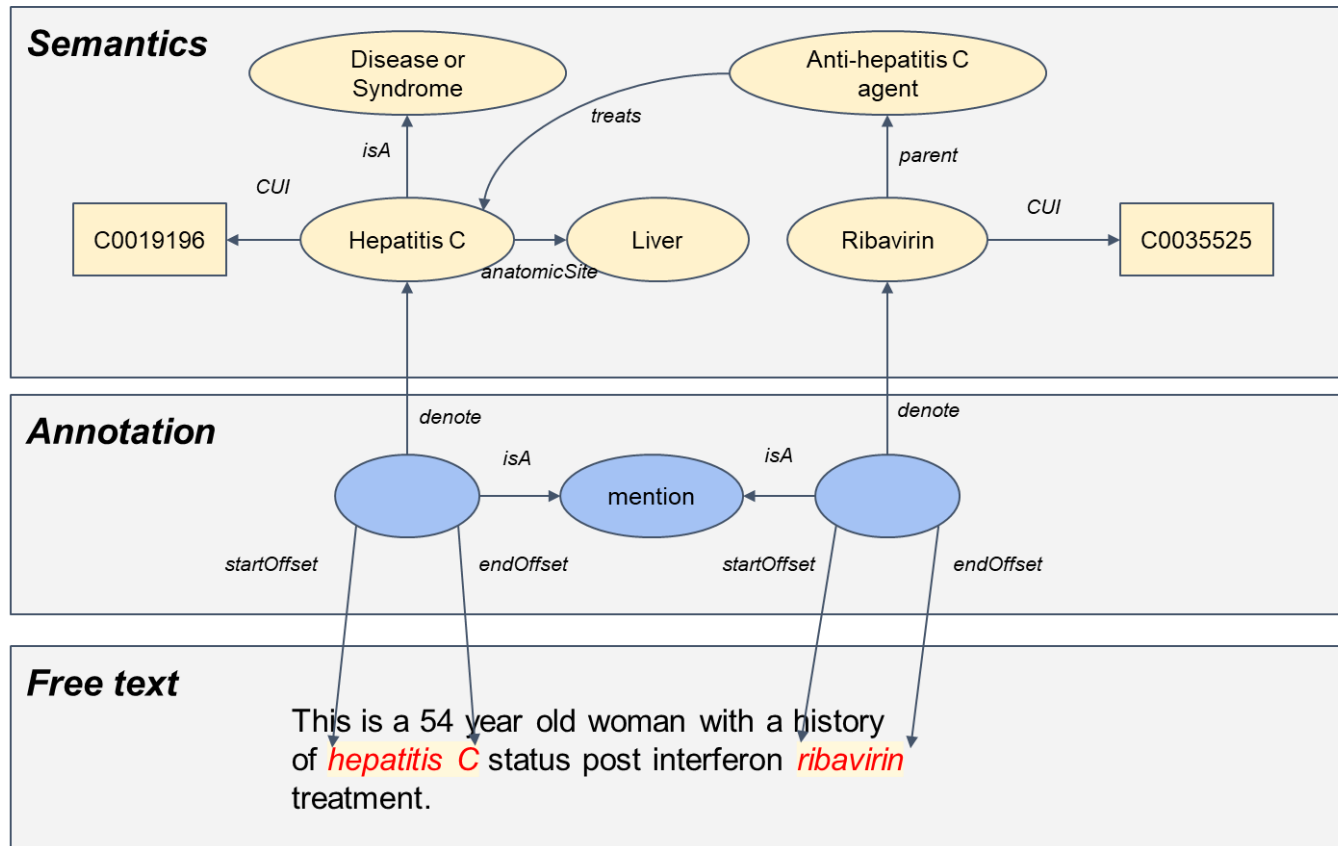
Training and testing AI by rotating through hospitals



Model	Training Configuration	Hospital Test Site	# Annotated Examples	F1 μ
M1	Base - No Training	KCH	3,358	0.638
M2	Base + Self-Supervised MIMIC-III	KCH	3,358	0.840
M3	Base + Self-Supervised KCH	KCH	3,358	0.889
M4	KCH Self-Supervised + KCH Supervised	KCH	3,358	0.947
M4	KCH Self-Supervised + KCH Supervised	UCLH	499	0.903
M5	KCH Self-Supervised + KCH Supervised + UCLH Self-Supervised	UCLH	499	0.905
M6	KCH Self-Supervised + KCH Supervised + UCLH Self-Supervised + UCLH Supervised	UCLH	499	0.926
M4	KCH Self-Supervised + KCH Supervised	SLaM	1,425	0.885
M7	KCH Self-Supervised + KCH Supervised + SLaM Self-Supervised	SLaM	1,425	0.907
M8	KCH Self-Supervised + KCH Supervised + SLaM Self-Supervised + SLaM Supervised	SLaM	1,425	0.945

Natural Language Understanding

Mapping Language to Meaning

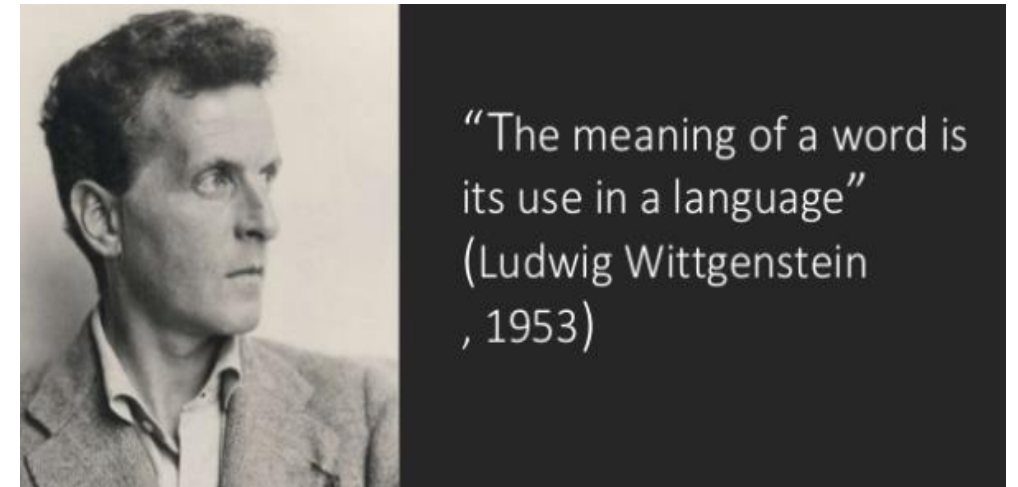


Representation of meaning (Semantics)

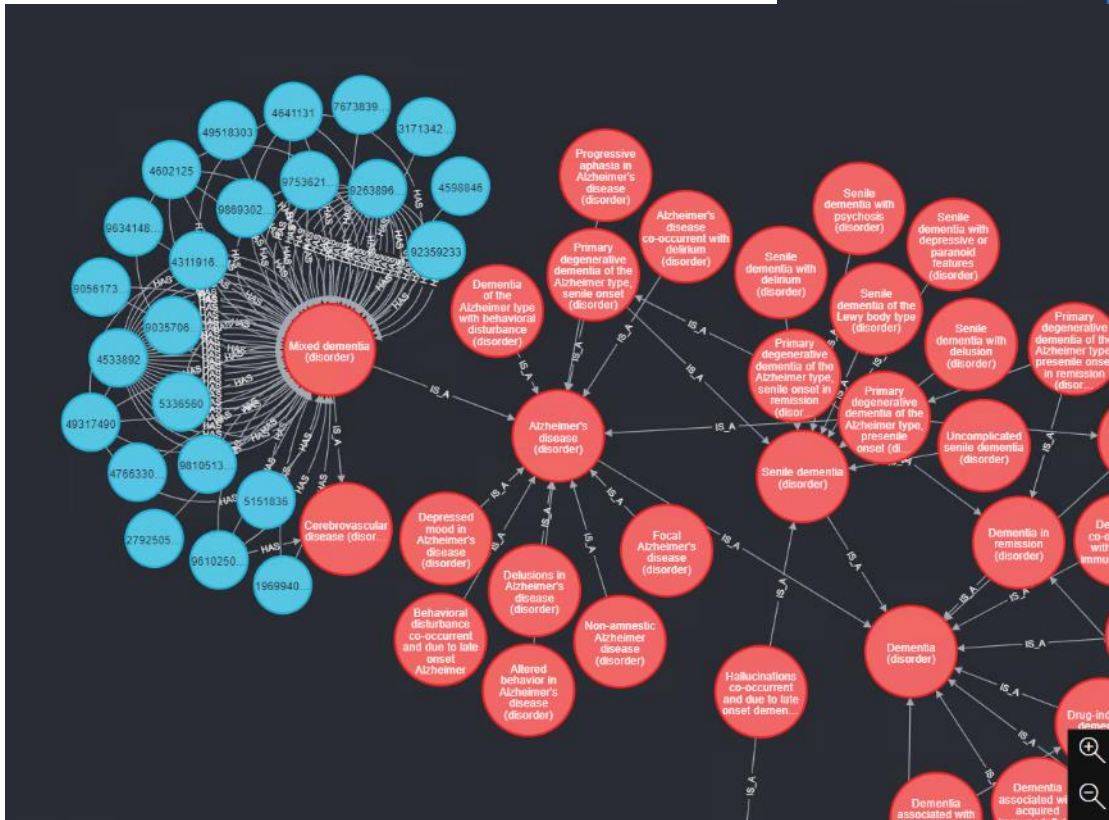
Like a dictionary but with mappings for meaning

Meaning as defined by context

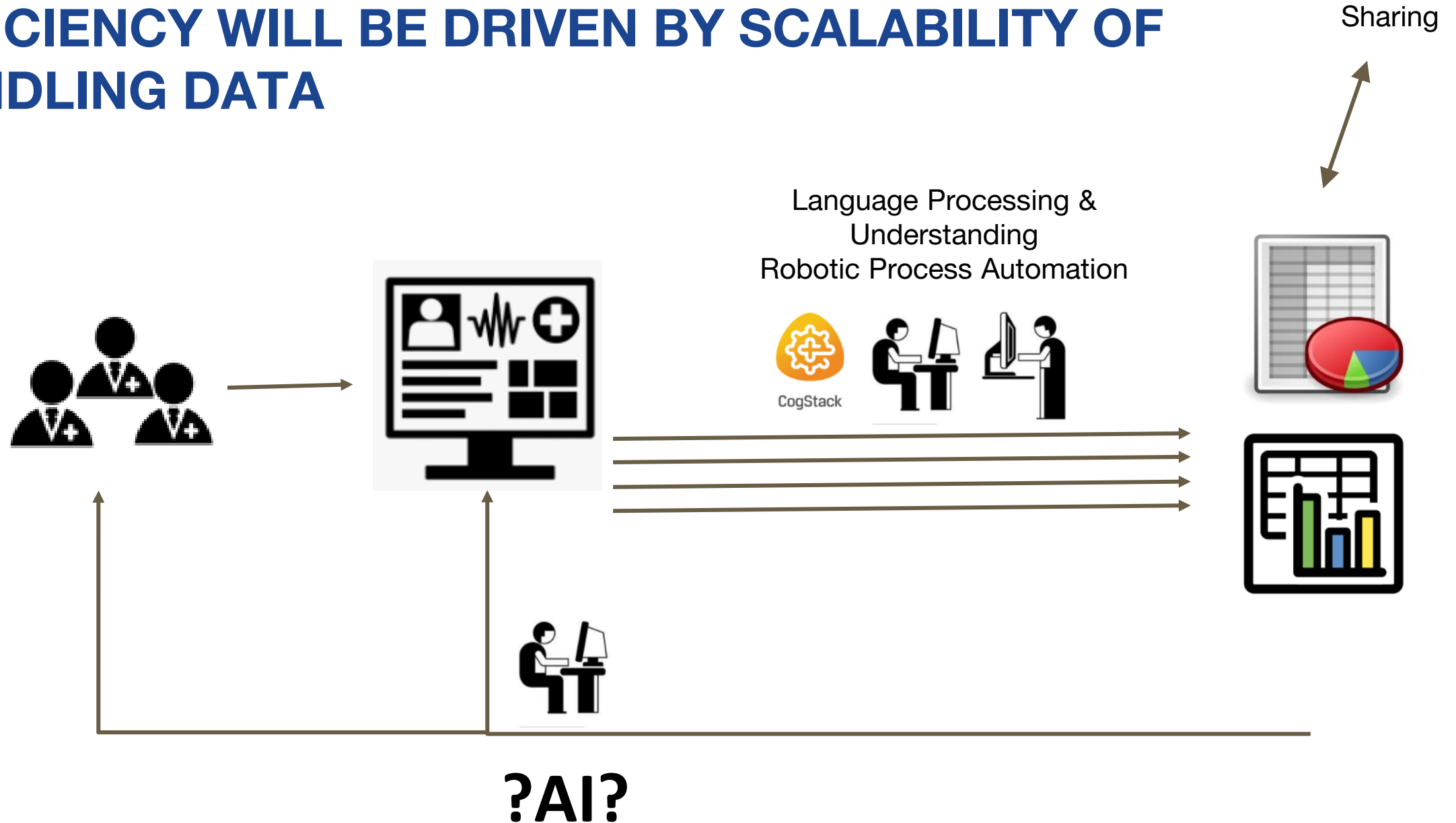
Allows machines to assign human-based meaning to words



Semantic maps to produce machine-readable meaning



EFFICIENCY WILL BE DRIVEN BY SCALABILITY OF HANDLING DATA



EFFICIENCY WILL BE DRIVEN BY SCALABILITY OF HANDLING DATA

To use data technologies, one needs to be able to clean, sort and arrange data **continuously and rapidly**

EHR's which structure data at source is helpful, but oversized EHR's pass the load of cleaning and structuring data to frontline staff which is the **opposite of efficiency**

NLP and Semantic technologies are past the Proof-of-Concept stage and deployments have started in some organisations

Further maturation is necessary to integrate them into workflows and then feed the data back for actionable changes

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