



Bradford Teaching Hospitals
NHS Foundation Trust

SILICON DALE

BREAKING NEW AI GROUND IN BRADFORD

Tom Lawton – Bots4Good November 2019

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Bradford

- “Most Improved” 2019
- 6th largest district in UK
(overshadowed by Leeds!)
- Multi-ethnic
- Youngest, fastest growing
- Highest and lowest deprivation in UK





BTHFT

- One of “Most Improved” digital pioneers, without being a Global Digital Exemplar
- Cerner Millennium EPR – 2yrs
- BIHR onsite
- “Working as one”

City of Research

- Bradford Institute for Health Research
- Connected Bradford
- Combined forces of BTHFT, GPs, CCGs, Council, YAS & others



All about me

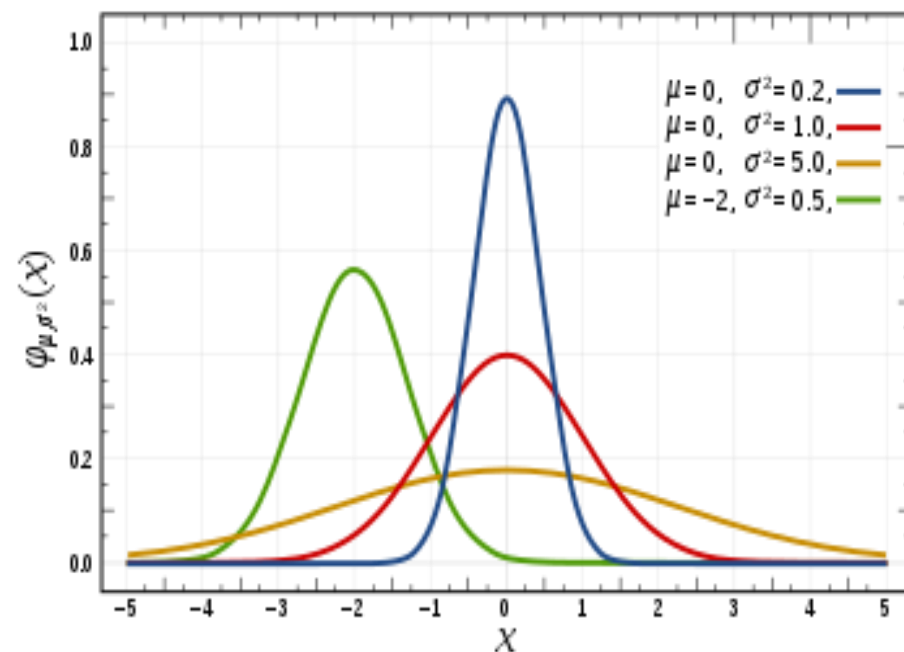
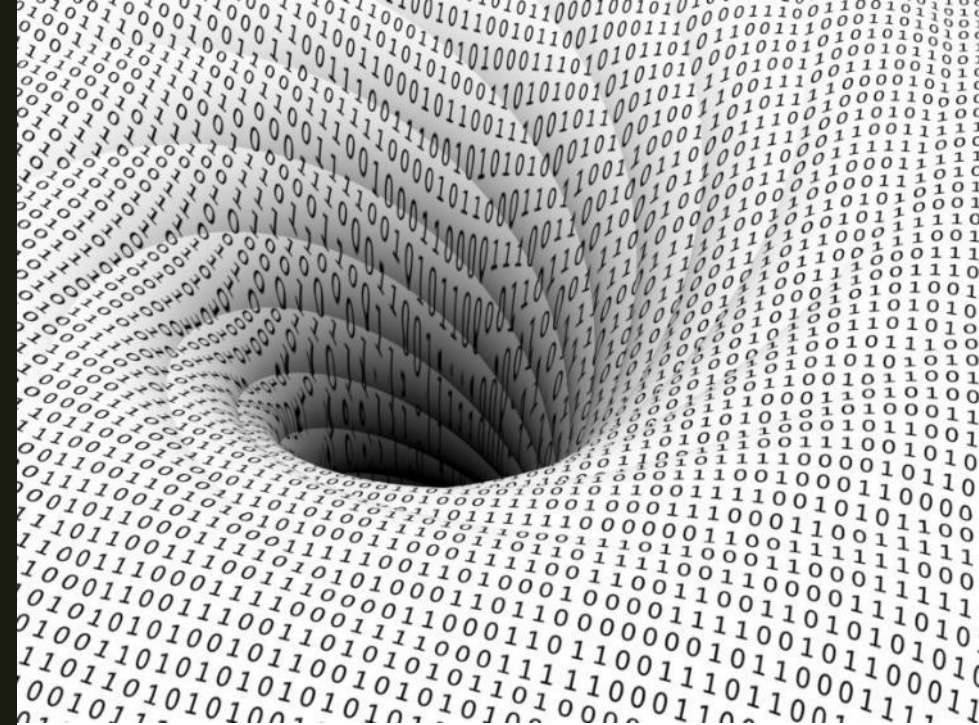
- Former programmer
- Medicine & Philosophy
- Armchair data scientist
- Neural nets & Bidirectional Associative Matrices
- RCP Health Informatics, EPR Setup
- BIHR work on safety/modelling

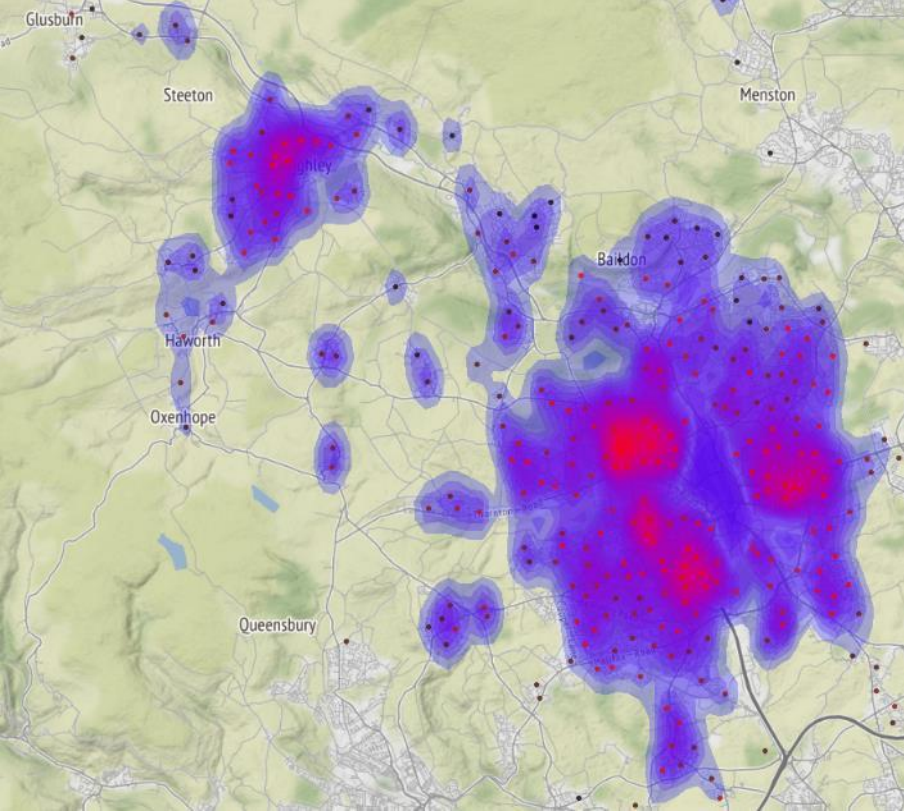
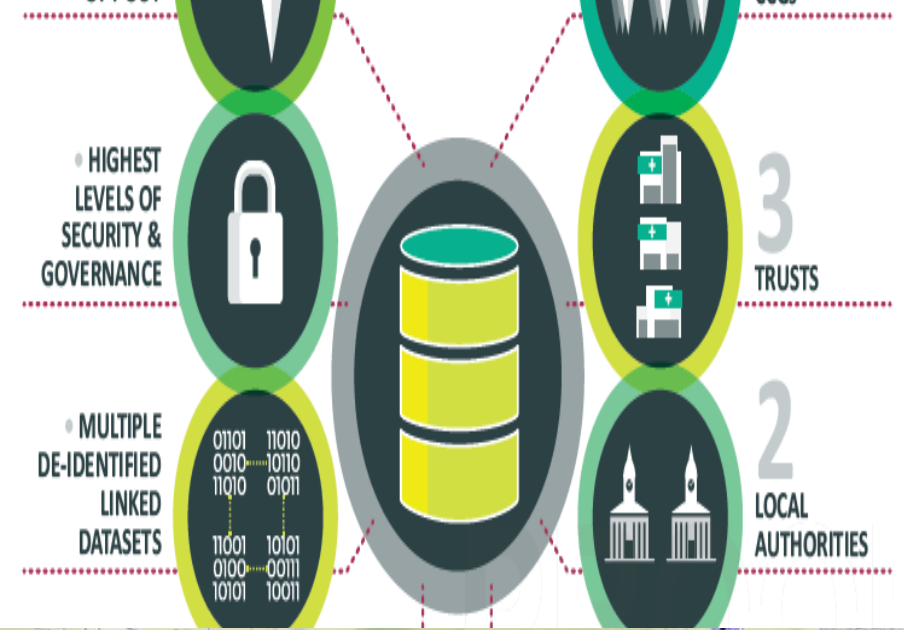
Big Data

- “Also known as data”
- Define by volume?
- Define by processing?
- Sample vs population

Can we avoid reducing people down to components for analysis?

“Pati-ants”





Silicon Dale

■ “Everything is connected”

Researchers

Engineers

Data Scientists

Clinicians

Policymakers

Patients (& their data!)

AI Aspirations

■ AI Expertise - Universities

Bradford

Leeds

York

■ Clinicians with Problems

Principally around having a full hospital!

■ Data

cBradford



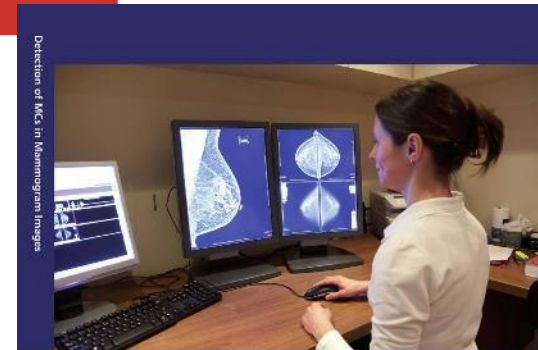
Tufan Colak
Rami Qahwaji

AUTOMATED PREDICTION OF SOLAR FLARES

Integrating Image Processing and Machine Learning for
the Creation of a Hybrid Computer Platform
that Provides Real-Time Prediction of Solar Flares



AUTOMATED PREDICTION OF SOLAR FLARES



Ayman AbuBaker
Rami Qahwaji

Detection of Breast Cancer Microcalcifications in Mammograms

Automated Computer Aided Diagnosis System for
the Detection & Classification of Microcalcifications
in Mammogram Images



Ayman AbuBaker, R. Qahwaji



Early projects – AI based

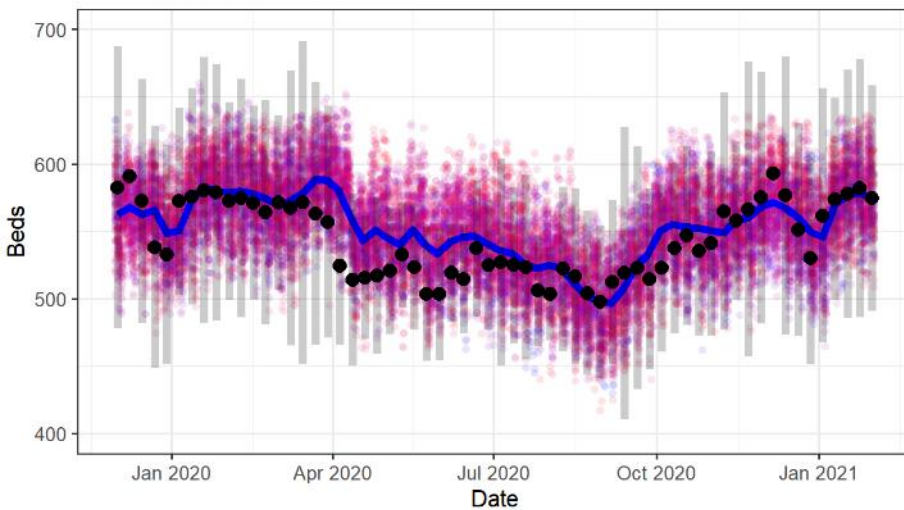
■ Modelling

Whole hospital model

Links with NHS-R

■ Command Centre project

Real and modelled bed use



Early projects – true AI

■ Predictive analytics

Tests in A&E

Length of stay

Delayed discharge

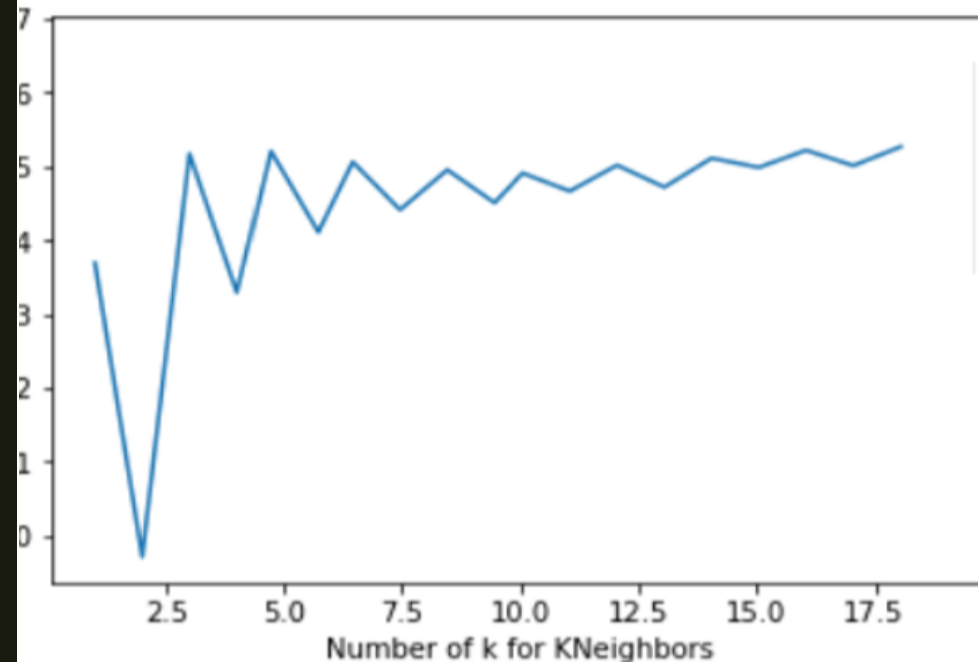
■ Safety

Oesophagectomy surgery

Sepsis

■ Interesting, but no clear path to impact

```
1 #!/usr/bin/env python3
2 #- coding: utf-8 -*-
3 """
4 Created on Wed Aug 7 14:11:26 2019
5 @author: johnmarko
6 """
7
8 import numpy as np
9 import pandas as pd
10 import matplotlib.pyplot as plt
11 import seaborn as sns
12
13 data= pd.read_csv("data.csv")
14
15 data.columns
16 data.dtypes
17
18
19
20
21 cat_data = data.select_dtypes(include=['object']).copy()
22 ethnic_count = cat_data['Ethnic.Category'].value_counts()
23 sns.set(style="darkgrid")
24 sns.barplot(ethnic_count.index, ethnic_count.values, alpha=0.9)
25 plt.title('Frequency Distribution of Carriers')
26 plt.ylabel('Number of Occurrences', fontsize=12)
27 plt.xlabel('Carrier', fontsize=12)
28 plt.show()
29
30 labels = cat_data['Ethnic.Category'].astype('category').cat.categories.tolist()
31 counts = cat_data['Ethnic.Category'].value_counts()
32 sizes = [counts[var_cat] for var_cat in labels]
33 fig1, ax1 = plt.subplots()
34 ax1.pie(sizes, labels=labels, autopct='%1.1f%%', shadow=True) #autopct is show the % on plot
35 ax1.axis('equal')
36 plt.show()
37
38 labels = cat_data['Ethnic.Category'].astype('category').cat.categories.tolist()
39 replace_map_comp = {'Ethnic.Category': [(k, v) for k, v in zip(labels, list(range(1, len(labels))))]}
40 print(replace_map_comp)
41 data.replace(replace_map_comp, inplace=True)
42
43 cols_to_norm=['Sex', 'Ethnic.Category', 'A.E.Arrival.Mode',
44             'A.E.Attendance.Disposal', 'A.E.Incident.Location.Type',
45             'A.E.Patient.Group', 'Source.of.Referral.For.A.E',
46             'Age.at.CDS.Activity.Date', 'Accident.And.Emergency.Treatment...First',
47             'Accident.And.Emergency.Treatment...Second', 'Accident.And.Emergency.Treatment...Third']
48
49
50
51
52 data[cols_to_norm] = data[cols_to_norm].apply(lambda x:(x - x.min())/(x.max()-x.min()))
53
54 print(data.describe())
55
56
```



Barriers in the NHS

■ Infrastructure

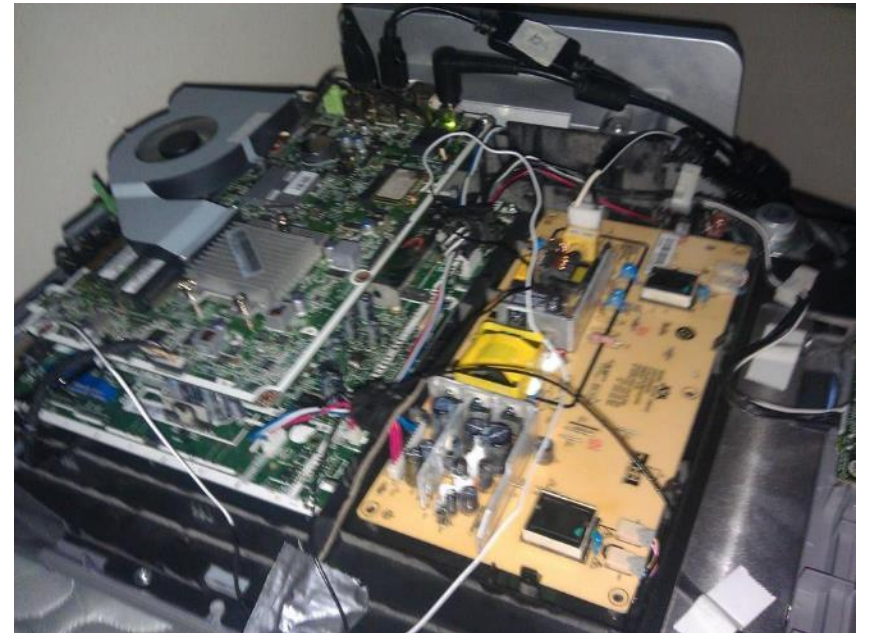
Computing power
Software

■ Data

Information governance
Information “ownership”

■ Impact

Clinician involvement
Solving real problems



Safety Assurance

- **University of York**

Healthcare systems keep changing

Positive deviance

Work as imagined vs work as done

- **“Safety 2.0”**

- **Using AI to update safety cases**

The gas turbine has three main sections: the compressors, the combustion system, and the turbines.

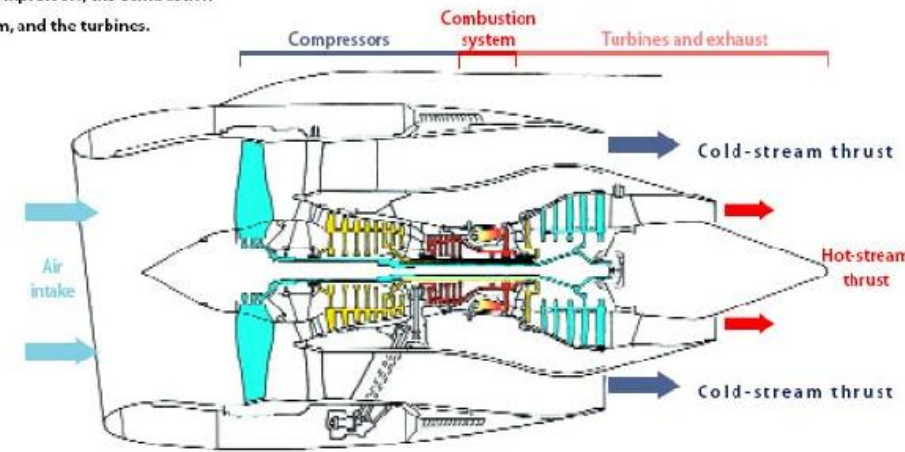
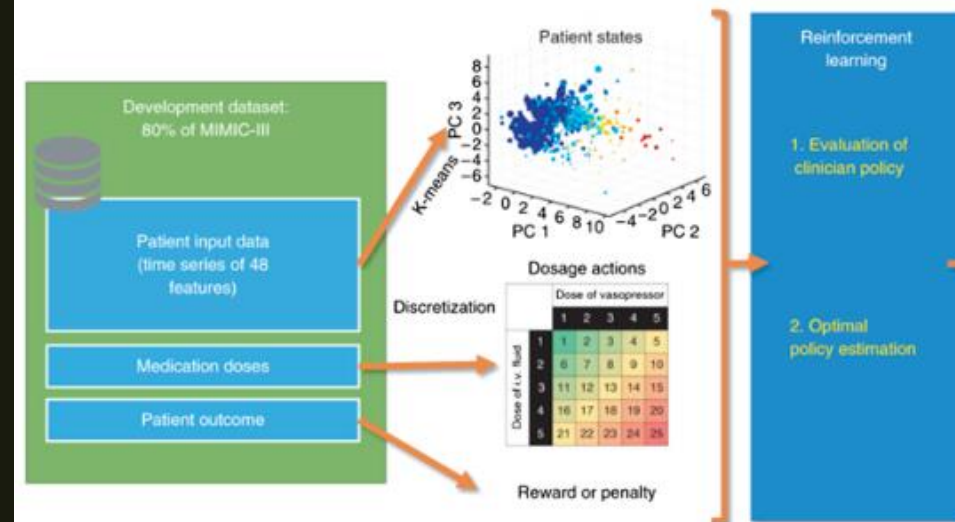


Figure 1. Gas Turbine Engine



Safety & the AAIP



Cross-Discipline Working

■ Back to philosophy!

Self driving cars

The “AI Clinician”

■ “Mind The Gaps”

Semantic Gap

Responsibility Gap

Liability Gap



Contents lists available at [ScienceDirect](#)

Artificial Intelligence

www.elsevier.com/locate/artint



Mind the gaps: Assuring the safety of autonomous systems from an engineering, ethical, and legal perspective



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ABSTRACT

This paper brings together a multi-disciplinary perspective from systems engineering, ethics, and law to articulate a common language in which to reason about the multi-faceted problem of assuring the safety of autonomous systems. The paper's focus is on the “gaps” that arise across the development process: the semantic gap, where normal conditions for a complete specification of intended functionality are not present; the responsibility gap, where normal conditions for holding human actors morally responsible for harm are not present; and the liability gap, where normal conditions for securing compensation to victims of harm are not present. By categorising these “gaps” we can expose with greater precision key sources of uncertainty and risk with autonomous systems. This can inform the development of more detailed models of safety assurance and contribute to more effective risk control.

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Ongoing plans



■ Overall

Realise potential of EPR
Pathway to impact

■ Projects

Radiology/visual AI
Predictive analytics
Population health

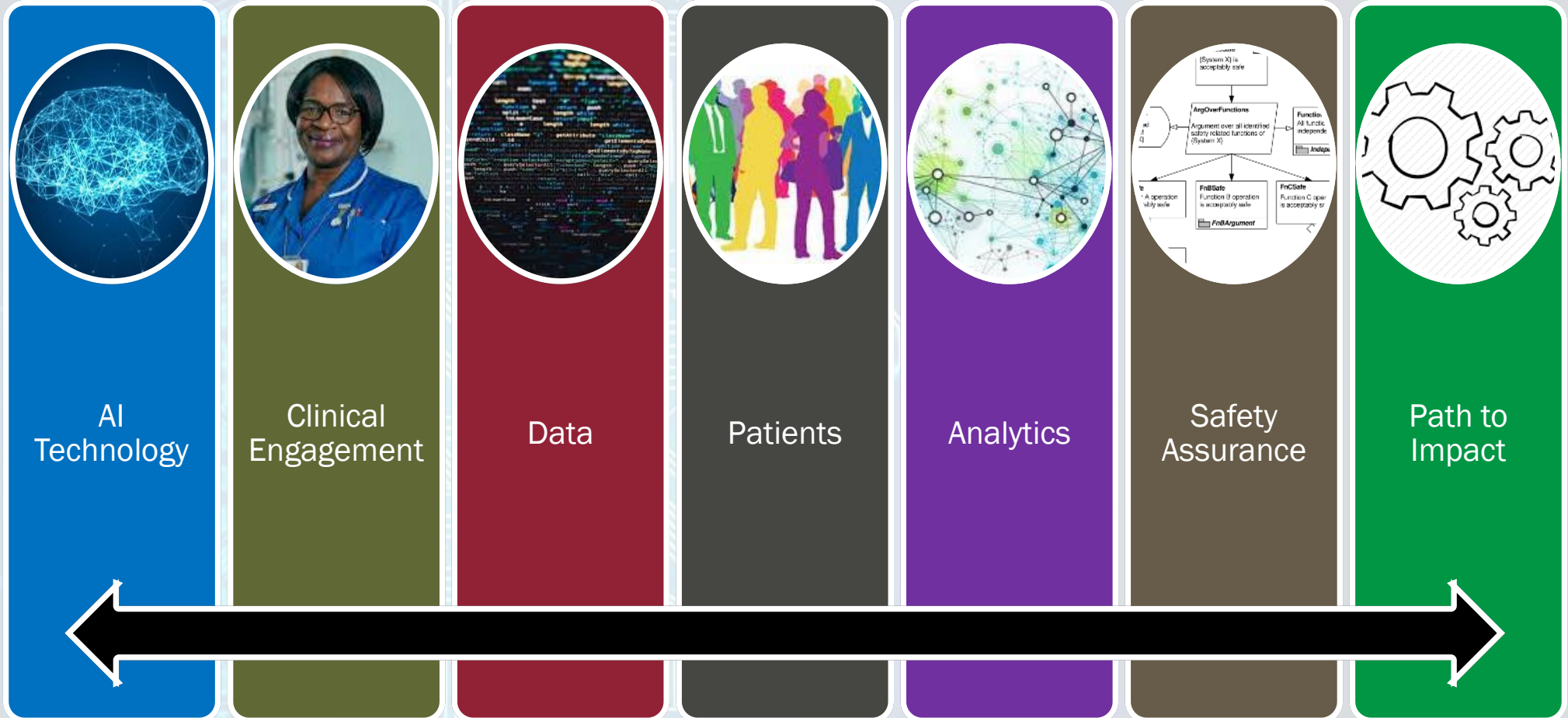
■ Data - cBradford expansion

Wider population
Other determinants of health

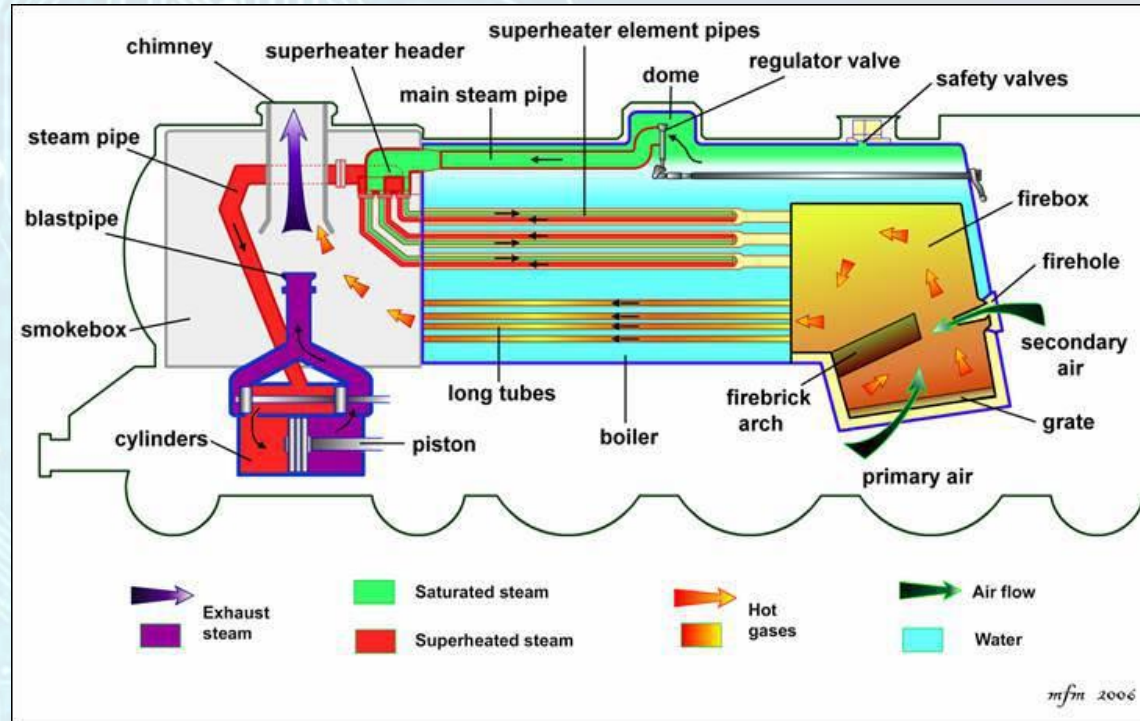
■ Safety Assurance

Dynamic safety cases
Online machine learning

“Everything Is Connected”



Thank You



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