

# EMIF: E-Managing the Future of Health Data

in association with



## Coupling Evidence with Real World: A two-way street: rethink translation

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@FarrInstitute

Optimizing Execution, Feasibility and Efficacy  
Budapest, 17<sup>th</sup> March 2016



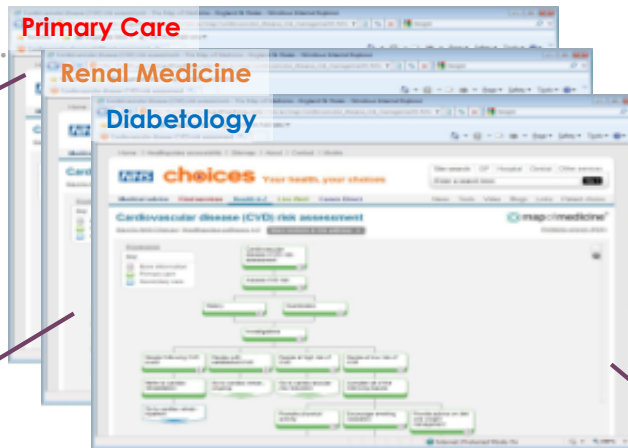


# Real World Care Pathways are Mashups

Total evidence-base predicts < 30% healthcare outcomes  
A fog of biomarkers is not a 'usefully complex' solution

His primary care clinician...

General view:  
diet, exercise,  
polypharmacy



Frank...



His diabetologist...

Glucose focus

Where is the evidence of how lifestyle factors affect say SGLT2 vs. DPP4 drug choices?

His nephrologist...

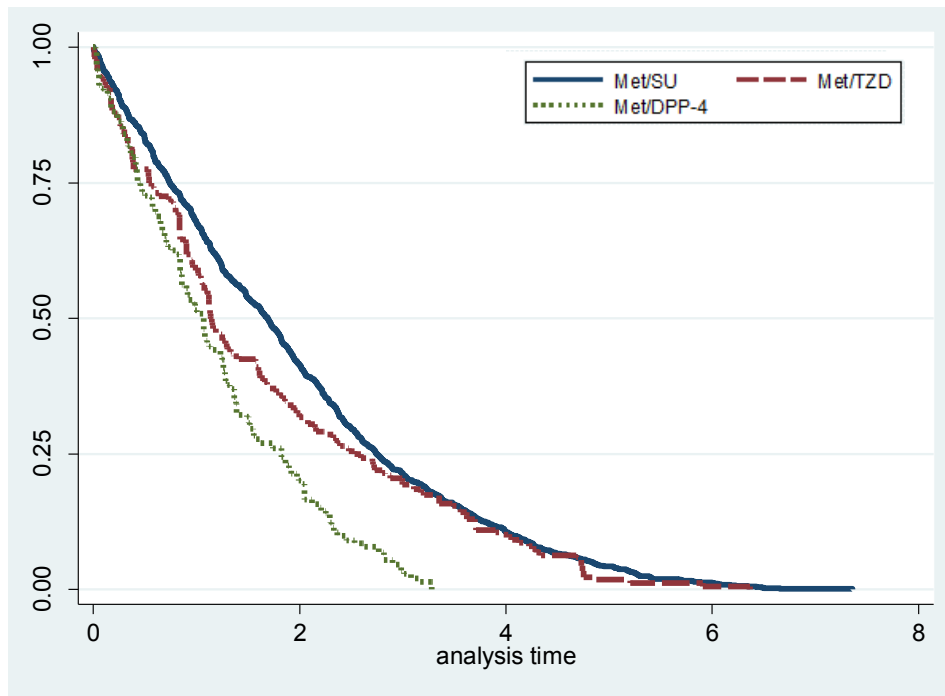
BP focus

Evidence needed is the union not sum of models

↑ Weight  
→ ↑ BP

Valderas JM, Starfield B, Sibbald B, Salisbury C, Roland M. Defining comorbidity: implications for understanding health and health services. *Ann. Fam.* 2009;7:357-363.

# Dual Therapy for Diabetes: Big Data?



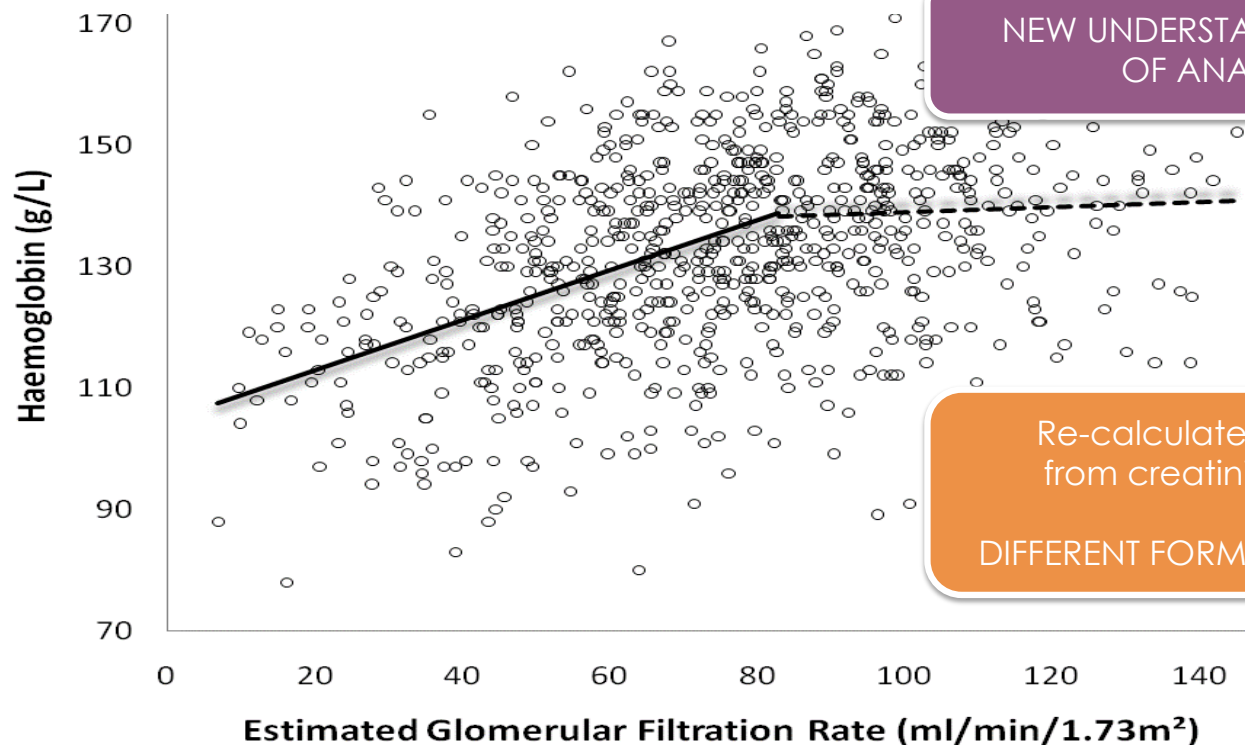
Data source: CPRD  
Analysis: A Wright, D Ashcroft, R Emsley

Deep dive with CPRD data:  
Time to microvascular event from diagnosis of diabetes using inverse probability weighted marginal structural model to estimate average causal effects of dual therapies

Heterogeneity of individual treatment response:  
need deeper contextual data for...

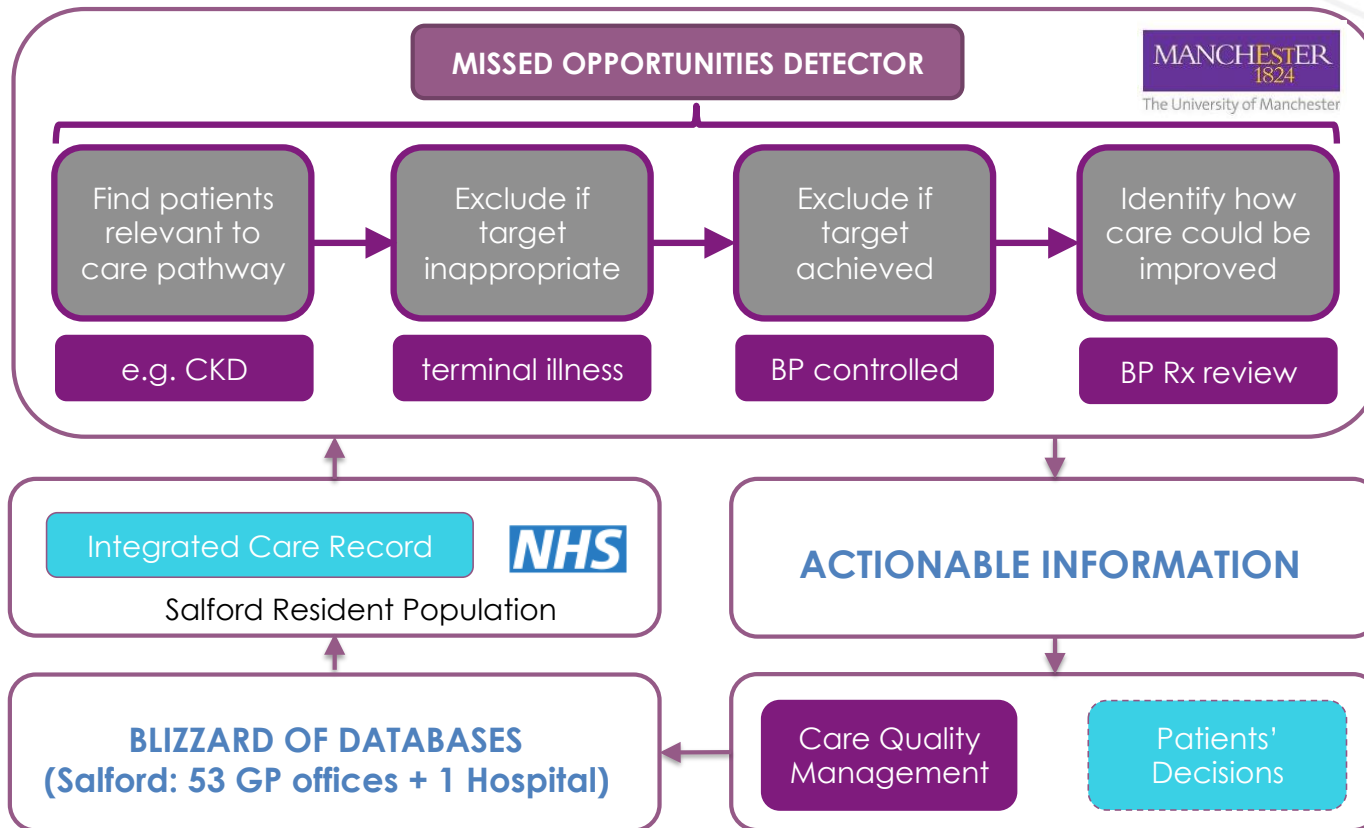
Stratified Med. (find & treat subgroups)  
Personalised Med. (optimise individual response)

# Contextual Metadata



New JP et al. The high prevalence of unrecognized anaemia in patients with diabetes and chronic kidney disease: a population-based study. *Diabet Med.* 2008 May;25(5):564-9.

# Actionable Analytics for Health Systems



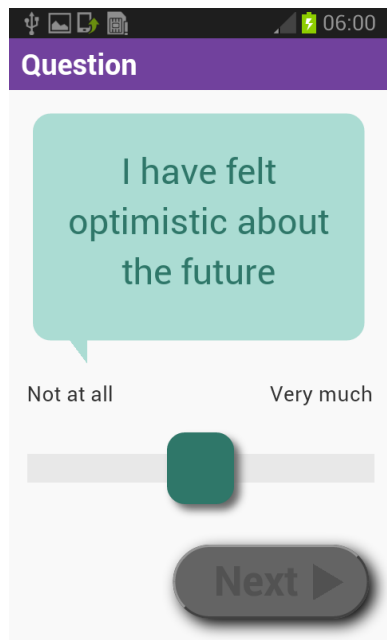
Actionable information attracts: trust & traction from patients, public and practitioners... and better data quality.

Brown B et al. Missed opportunities mapping: computable healthcare quality improvement. *Stud Health Technol Inform.* 2013;192:387-91.

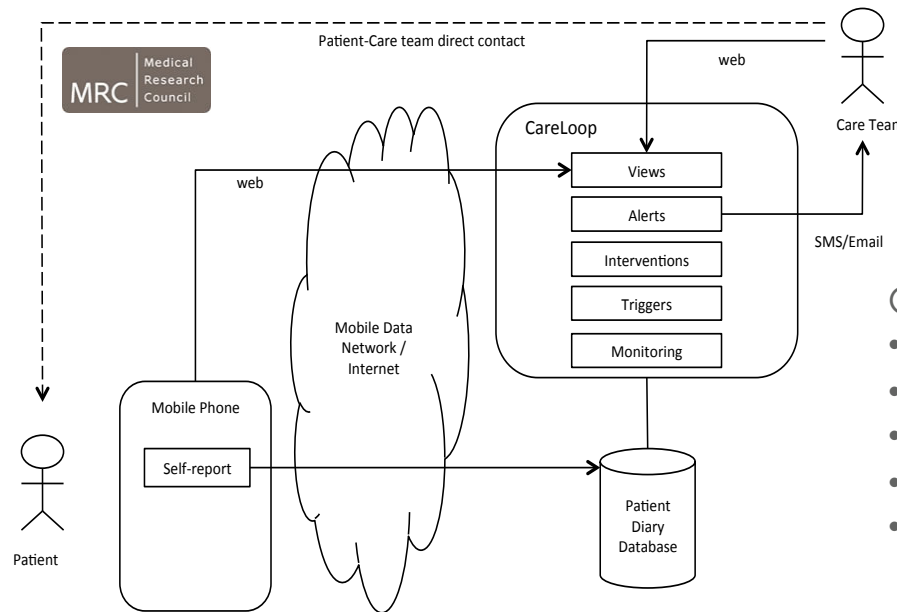


# Combined Patient-Care System Actions

Aim: To Reduce Relapse in Schizophrenia via Smartphone  
 Drug + behaviour (information \* psychological endotype) = outcome



[www.clintouch.com](http://www.clintouch.com)



Informatics intervention

Informatics enabled observation

Generic:

- Self-measurement
- Symptom awareness
- Clinical workflow integration
- Self-efficacy / autonomy
- Alert-fatigue avoidance



# Co-produced Outcomes: Physical Activity



## News

### More steps a day keep the doctor away

05 Nov 2015

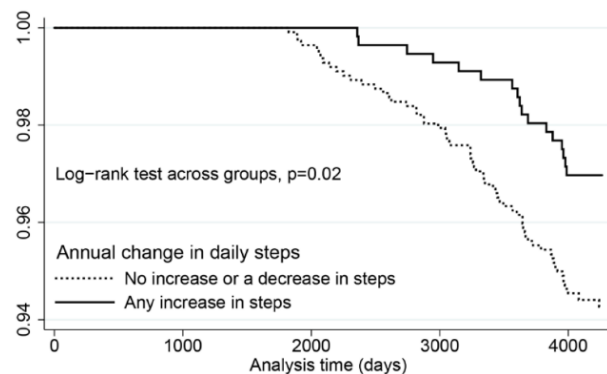


Fig 1. Kaplan-Meier probability estimates of survival by annual change in daily step activity from baseline to repeat interview, among Tasped participants with serial pedometer measures.

doi:10.1371/journal.pone.0141274.g001

PUBLIC RELEASE: 16-MAR-2016

## The Lancet Diabetes & Endocrinology: Public transport, walking and cycling to work are all associated with reductions in body fat for adults in mid-life

THE LANCET

Adults who commute to work via cycling or walking have lower body fat percentage and body mass index (BMI) measures in mid-life compared to adults who commute via car, according to a new study in *The Lancet Diabetes & Endocrinology* journal.

Even people who commute via public transport also showed reductions in BMI and percentage body fat compared with those who commuted only by car. This suggests that even the incidental physical activity involved in public transport journeys may be important.

Dwyer T et al. Objectively Measured Daily Steps and Subsequent Long Term All-Cause Mortality: The Tasped Prospective Cohort Study. *PLoS One*. 2015;10(11):e0141274.



# Integrated Clinical-Wellbeing Modelling

## Given:

Low-cost, easy wear and ubiquitous tech captures the digital by-products of the rhythms of life



## Challenge:

Mrs Jones

76 year old lady with  
COPD and depression  
2 previous falls

Accelerometry signals from:  
Respiratory U mental health U frailty

**Different** companies or research groups  
need **analytics** that **borrow strength** in  
an open innovation environment

# Causality and Frequent Observation

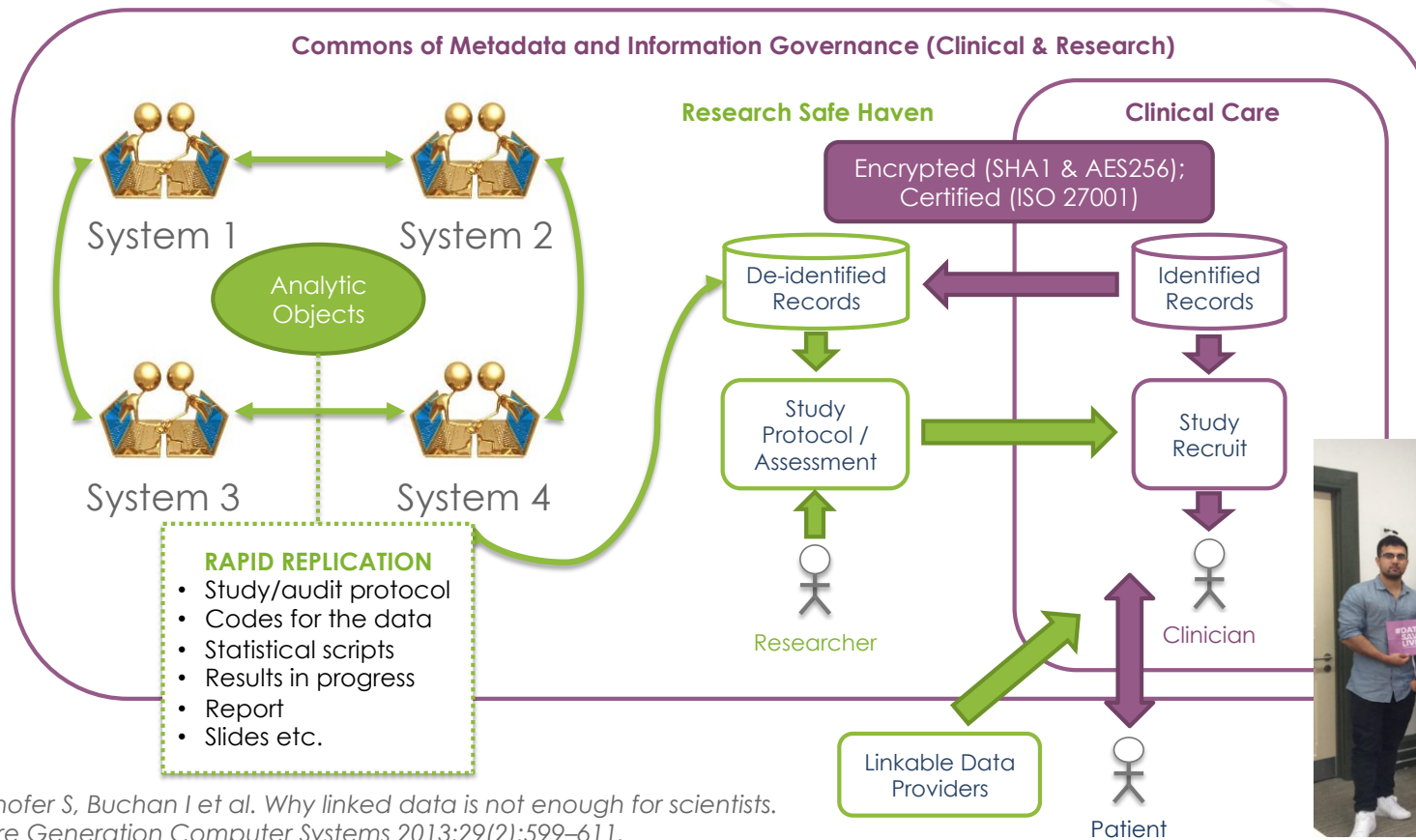
- What came first, weighing or weight-loss?



- An additional monthly weighing is associated with an extra 1kg weight lost over the course of a year
- Recent weight loss encourages subsequent measurement: a person who has recently lost 1kg is twice as likely to reweigh on a given day compared with someone who has remained the same weight

Sperrin M et al. Who Self-Weighs and What Do They Gain From It? A Retrospective Comparison Between Smart Scale Users and the General Population in England. *J Med Internet Res.* 2016;18(1):e17.

# Scalable, Always-on Analytics

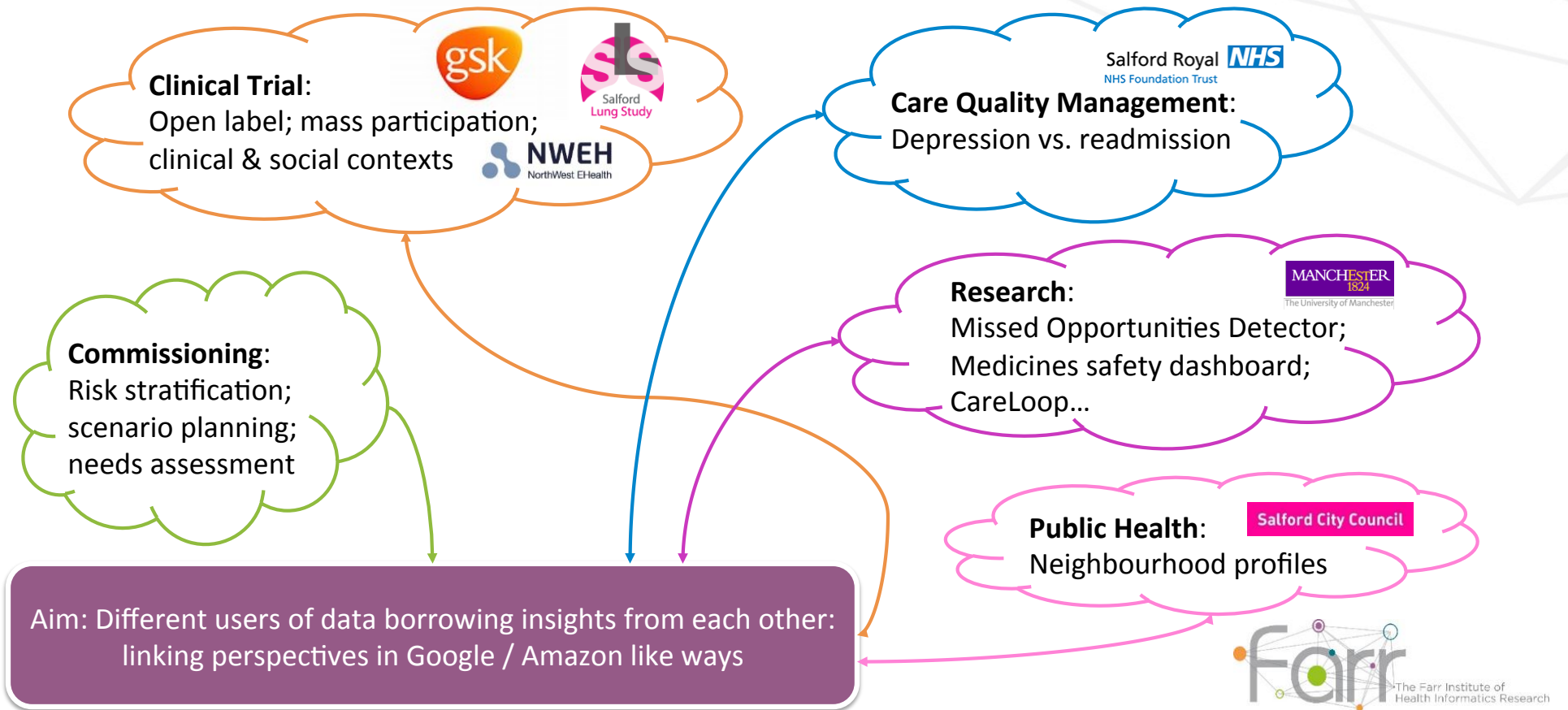


Ainsworth J, Buchan I. e-Labs and Work Objects: Towards Digital Health Economies. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering. Springer, Berlin Heidelberg 2009;16:206-216.

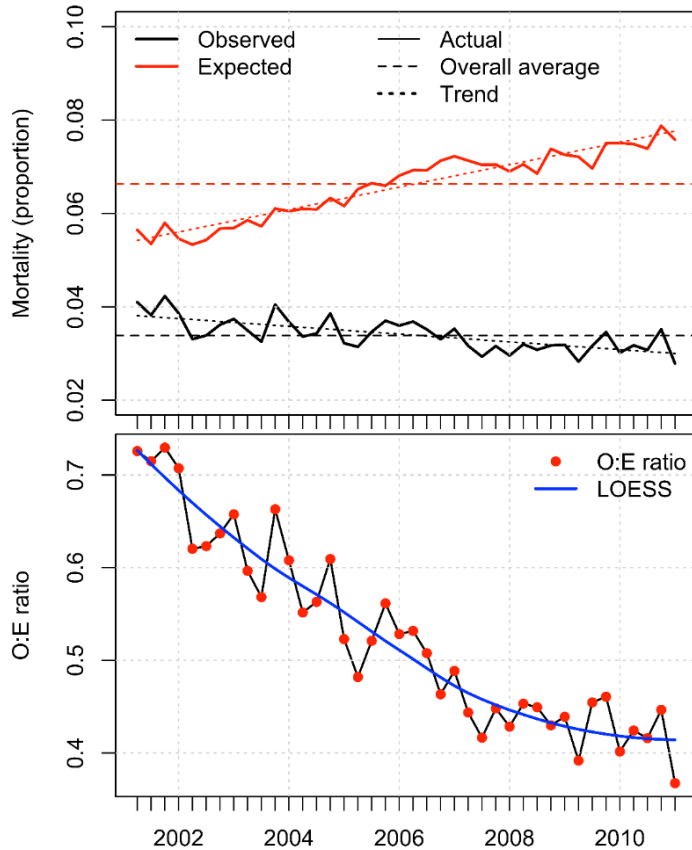


Bechofer S, Buchan I et al. Why linked data is not enough for scientists. Future Generation Computer Systems 2013;29(2):599-611.

# Real World Trials: Need Reusable Apparatus



# Outcome Prediction: Calibration Drift



EuroScore prediction

Observed death rate

Calibration drift:  
Typical of many  
published models

Hickey GL et al. Dynamic trends in cardiac surgery: why the logistic EuroSCORE is no longer suitable for contemporary cardiac surgery and implications for future risk models. *Eur J Cardiothorac Surg.* 2013 Jun; 43(6):1146-52.

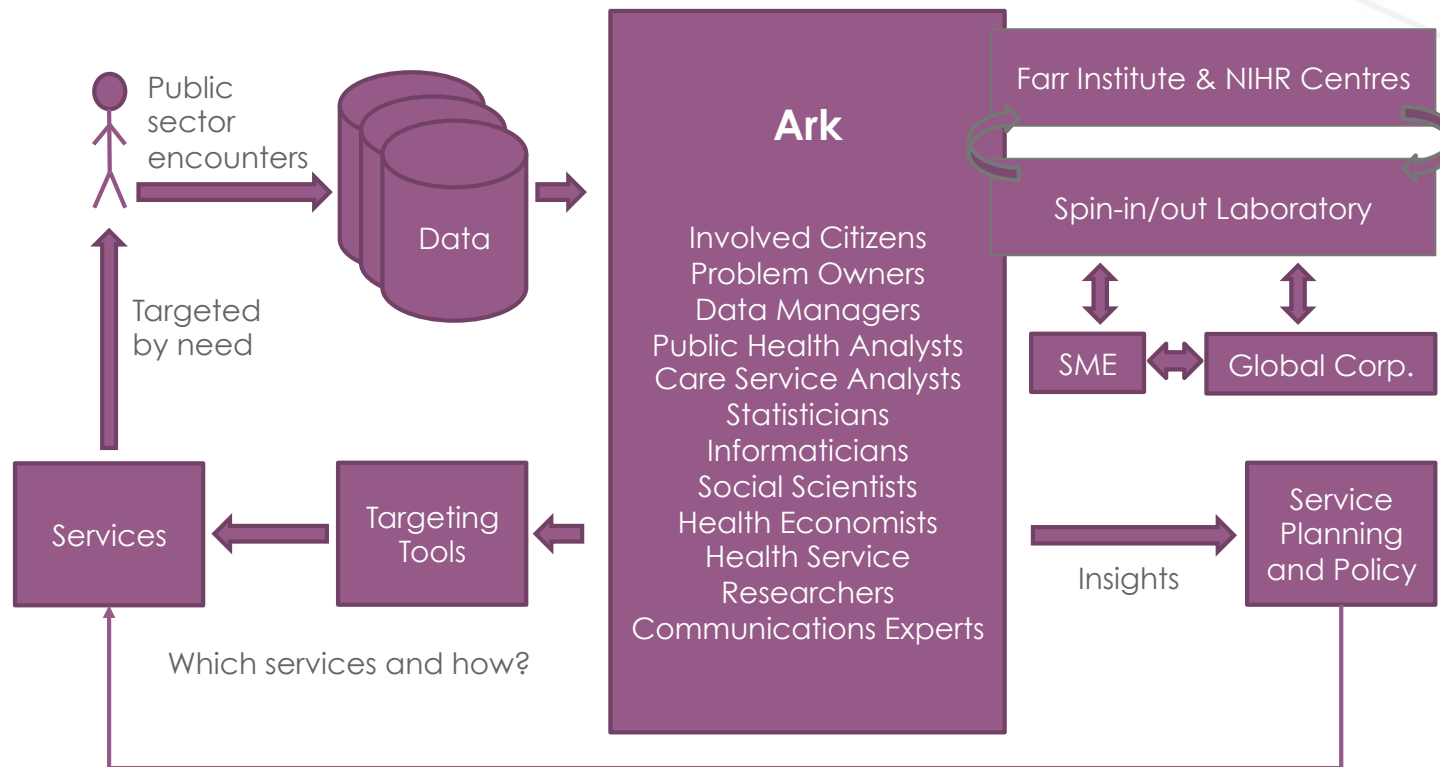
Academia rewards publishing papers on the same topic every 10y or so

Law sees algorithms as medical devices (EU Directive 2007/47)

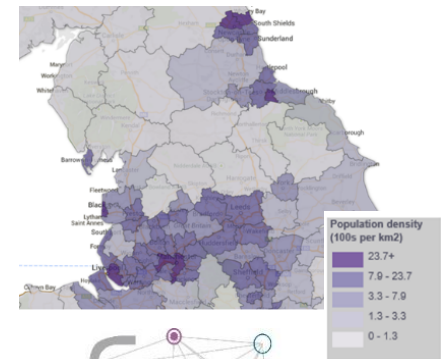
Industry has no trusted 3<sup>rd</sup> party lab for validating algorithms/models

[twitter.com/hashtag/datasaveslives](https://twitter.com/hashtag/datasaveslives)

# Civic Health Data Analytics



**Connected Health Cities**  
Pilots 2016-9  
North England



Ainsworth J, Buchan I. Combining Health Data Uses to Ignite Health System Learning. *Methods Inf Med.* 2015 Nov 27;54(6):479-87.



## Parting thoughts

Somewhere over the big data rainbow,  
my health **avatar might say no** to your care pathway.

Prepare for patients to **own clinical equipoise**,  
but who governs routine randomisation?

Start modelling real world care from the **middle out**,  
biology-to-patient AND patient-to-population/place/system.

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