‘i’-Health Challenge: Science Service Synchrony

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This Talk

• Current position:
  Unrealistic expectation of evidence into practice

• Envisioning ‘i’-Health:
  Understanding and improving healthcare care in sync.

• Next steps:
  Informatics research questions
Mirage: Evidence Cycle

Reality: feedback is too little too late

Algorithms may be out of date by the time they are “validated”

Note EU Directive 2007/47
Traditional Knowledge Management: “Evidence into Practice”: Informing Integrated Care Pathways (Disease-specific)
Challenge: Pathway for Mr Smith is NOT the SUM of Disease Guidelines

Future: Realistically complex and dynamic models of care: Incorporating interactions of different care pathways and Mr Smith’s previous responses

- **Self Care**
- **Clinical Care**
- **Primary Care**
- **Secondary Care**

**BMI**

**Physical Activity**

**Nephrology:**
- Hypertension → Chronic kidney disease

**Diabetology:**
- Glucose control → General vascular disease

Specialist A

Specialist B
Health Records & Knowledge Silos

Data-intensive Paradigm shift

Open Unifying Modelling: Across mechanisms and contexts

Health Avatars & Dynamic Models

 models = Avatar

Multi-scale & Multi-system Health:
- Research
- Policy
- Care

Unified Graphical Model

Expertise

Data-intensive Paradigm shift

Large scale inference

Model refinement

e.g. Coronary heart disease

Health e-Records

e.g. Chronic obstructive pulmonary disease

e.g. Lung cancer

Data

Data

Data
Experimenting with a unified graphical modelling approach and some high quality longitudinal health(care) data

MACHINE LEARNED EPIDEMIOLOGY
Machine Learned Epidemiology

• Suspected myth: false division of children into allergic tendency (atopy) or not

• Life-course data: birth cohort of 1,000 children from Manchester with careful measurements

• Approach: unsupervised search for patterns of sensitisation → shape hypotheses
Model: Unsupervised Clustering of Allergic Sensitisation Across Ages
From 2 to 5 Useful Classes of Atopy
Better Prediction of Real-world Outcomes

Admitted at Any Age

First Admitted > 3 Years Old
(remove early virus wheeze)
Toward Service Science Synchrony

• State-of-art algorithms stratify population

• Clinicians explain strata and generate hypotheses with biologists

• Life science resources are focused on more meaningful endotypes
For “Real World Evidence”: Do we just need lots of eHR data?

Methods/Models/Applications Proliferation

Human Experts Don’t Scale (Crucial Metadata Factory)
Anaemia at lower levels of kidney impairment than commonly thought

Crucial Metadata = detail of creatinine assay, because records spanned introduction of standard eGFR reporting

Anaemia at lower levels of kidney impairment than commonly thought
Social Scaling of Sense-Making

“Direct Care”
- Local Community Integrated Health Record
- Depersonalised

“Meaningful Reuse”
- Commissioning Clinical Audit
- Local Research
- Public Health

“Enhanced Reuse”
- Collaborating “e-Lab”/district
- Corroborate finding
- Enrich interpretation
- Share methods & expertise

Work Object
- Consistent provenance tracks
- Visibility for contributors
- Reward for participation
- Reusable work
- Sense-making network
“Borrowing Strength” along Service Buses

Federation of e-Lab communities shares work or method objects without remote data warehousing.

Strength is borrowed and costs reduced by pooling expertise.
Exploit Heterogeneity

• Incorporating information about differences between settings improves research accuracy

• Global e-Lab Federation could achieve synchronous meta-analysis → more timely intelligence

Personal Health Record

• EU target: 20% citizens on-line healthcare records access by 2015

• New longitudinal signals → research

• Triangle of care
  – Patient co-producer
  – Clinician guide
  – Algorithm
PHR: ‘Access’ Approach

- Citizen rights & responsibilities
- Primary care example: over 75% of patients keep accessing records
- Place for health information exchange beyond clinical encounter
PHR: ‘Asset’ Approach

- Citizen choice and market development
- Emerging business models:
  - Non-profit to increase healthcare efficiency
  - For-profit to open markets e.g. pharmacy-citizen
‘i’-Health Synchrony

Coherently integrated data

People with relevant expertise and authorisation

State-of-the-art algorithms/models

‘Pre-primary’ Care
Asymptomatic: Health Risks to Manage

Wellbeing

Primary Care

Secondary+ Care

Personal & Community Health Intelligence
Large scale inference

Unified Graphical Model

Health Records & Knowledge Silos

Data-intensive Paradigm shift

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Large scale inference

Model refinement
i-Health Key Challenges

1. How to **multiply** analytical activity between health **sciences** and **services**?

2. How to **network** experts for timely **insight**?

3. How to create a **virtuous circle** between **citizen**, health **professional** and **algorithm**?