i-Health Challenge: Science Service Synchrony

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‘i’-Health Challenge: Science Service Synchrony

Medical Informatics Europe, Oslo, 29th August 2011

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Algorithms may be out of date by the time they are “validated”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

Nephrology:
- Hypertension → Chronic kidney disease

Diabetology:
- Glucose control → General vascular disease

Self Care
Clinical Care
Primary Care
Secondary Care
BMI
Physical Activity
Specialist A
Specialist B
Large scale inference
Unified Graphical Model

Health Records & Knowledge Silos

Data-intensive Paradigm shift

Open Unifying Modelling:
Across mechanisms and contexts

Health Avatars & Dynamic Models

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

Health e-Records

Expertise

Unified Graphical Model

• Research
• Policy
• Care

Large scale inference

Model refinement

Data-intensive Paradigm shift

Expertise
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

- Asthma
- Asthma exacerbation after age 1
- Persistent wheeze
- Current wheeze

Five class model: Latent atopic vulnerability
- Non-dust mite
- Dust mite
- Multiple late
- Multiple early

N/A

77
11
24
24
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)

Data Deluge
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

Work Object

- Consistent provenance tracks
- Visibility for contributors
- Reward for participation
- Reusable work
- Sense-making network

“Enhanced Reuse”

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

Large scale inference

Model refinement

Unified Graphical Model

Expertise

Health e-Records

Data

e.g. Coronary heart disease

e.g. Chronic obstructive pulmonary disease

e.g. Lung cancer

- Large scale inference
- Model refinement
- Multi-scale & Multi-system Health:
  • Research
  • Policy
  • Care

Unified Graphical Model
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**?