Public Health e-Labs for a Global Digital Economy

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Public Health ‘e-Labs’
for a Global Digital Economy

WHO-PHI 2008 (Asia-Pacific), Delhi, 3-4 Nov 2008

Prof. Iain Buchan
University of Manchester
PHI Targets

• Digital Deserts
  Building *e-readiness* for the public’s health

• Digital Dust
  *Turning digital commodities into actions for the public’s health*
Situational Awareness of Rising Child-BMI: Example Wirral 3-yr-olds from 1988 to 2004

Three-monthly rolling average BMI SDS

SDS = standard deviation score from 1990 British Growth Reference charts – adjusts for age and sex of the child
Secular trend to increasing BMI is much greater in taller children

Source: Buchan et al. 2006
Health data-silo anthropology

‘data-tombs’...
Digital Dust (data deposit > use)
Public Health Info-economics

Problems with Public Health Information

– Too little
– Too late
– Can’t find it
– Can’t reproduce it
– Consumes more resource than it needs to
– Benefits invisible to healthcare providers
– Cost savings not measured
Cloud of millions of messages in the local health economy

Organise

Structured Data

Transform & Examine

Structured Data & Metadata
Health Records

Audit; Research; Intelligence

Depersonalise

Research & Decision Objects

e-Lab for a defined community

Local Ownership

Asset Enrichment

Unclear Public Good

Clear Public Good
Link on NHS number

Data Repository in PCT

Real-time

24-hourly updates

Trusted person poses question(s)

Patient-driven information into records

Person-identifiable and sensitive information removed

Optometrist

Eye screening

Community nurses

Podiatry

Deaths, Demographics etc.

Biomics Data

Outputs
What is an e-Lab?

...an information system bringing together data, analytical methods and people for timely, high-quality decision-making
Clinical audit question: “is diabetes care picking up enough treatable anaemia in patients with mild kidney impairment?”
→ Answer: No
→ Care pathway improvements
→ Next similar e-Lab query made easier
→ Deeper research...
Anaemia at lower levels of kidney impairment than commonly thought

Clinical (audit) questions leading to scientific findings: supporting sustainable healthcare-academic partnership

Anaemia at lower levels of kidney impairment than commonly thought
Serving health communities with high-quality health intelligence requires **metadata** from **local uses**...
Excellent research by-products of excellent service development

Local NHS

Local NHS

Local NHS

Service development

FIREWALL

e-Lab

e-Lab

e-Lab

Research Networks

Research

Federation of e-Labs → scalable & sustainable
Summarising care quality

Care improvement or case-mix change?
Population Policies & Behaviours

Biological Risk Factors
- Physical Activity
- Diet
- Smoking
- Deprivation
- Obesity (BMI)
- Cholesterol (LDL & HDL)
- Blood Pressure

Combined CVD Risk
- Diabetes or IGT

CVD Patient Groups
- Unstable Angina
- Chronic Angina
- Acute MI
- Early Heart Failure
- Recurrent MI
- MI survivors
- Severe Heart Failure

Combined CVD Risk

Outputs: Population-based incidence, prevalence; Deaths prevented; Life-Years; Life expectancy; Costs; Cost-effectiveness ratios

Developing models and software to make complex scenarios easy to explore in real time → democratise commissioning?

Outputs:
- CHD Death
- Non-CHD Death
- From any state

SUDS
NON-SUDS
Increasing Expectation of Models

• Research
  – Multi-level stochastic
  – Machine-learning
    • Omics
    • Image analysis

• Service-development
  – Graphical models & discrete event simulations

• Clinical & self-care decision support?
for( i = 1 to #random permutations) 
{
    for( j = 1 to #SNPs) 
    {
        for( k = 1 to #patients) 
        {
            disease status 
            vs. locus status \chi^2 
        }
    }
}

Given a typical 5k patients, 0.5m SNPs and 10k permutations:

20k \chi^2 calcs per sec on modern single core \Rightarrow 70 hrs  single SNPs;
\Rightarrow \approx 1,980 years for [n*(n-1)]/2 SNP pairs
Computational free-thinking, for insights from richly-observed health & environments
...the e-Research Digital Economy
Obesity Attributable Cancers

• What is & will be the obesity-attributable cancer burden?

• Setting: 30 countries

• Inputs needed:
  – site- and sex-specific cancer risk data
  – standardised risk estimation by site
  – sex- and age-specific risk exposure data (present & past)
  – up-to-date cancer incidence
  – trends in cancer numbers & population demographics

*Thanks to: Andrew Renehan*
Future Population Impact Numbers

Rising complexity & computational cost

WHO Infobase
GloboCan

Current Population Impact Numbers

Risk exposure trends
Tumour registries

Interpretation & Report

Meta-analysis

Systematic review

Protocol

Localising Evidence Needs PHI

Figure 3: Summary risk estimates by cancer sites in men
Safety Blind-spot: Tamoxifen

• Question: Is there a substantial burden of recurrent breast cancer due to interaction of tamoxifen with anti-depressants?
  – Plausible CyP450-2D6 competition (tam → end-oxifen)

• Blind-spots (missing from registers)
  – Recurrent cancers
  – Adjuvant therapies
  – Concurrent therapies
1. User logs on and submits query
2. Access control module authorizes request
3. Broker performs distributed query; 4. generate pseudonym keys
5. Per request keyed pseudonymisation
6. Data integration
7. Anonymisation and inference control
8. Storage
9. Data analysis and visualization

Salford PCT e-Lab

NWeH e-Lab Federation

NWCIS e-Lab

E-Lab Repository

NWCIS Registry

3 & 4 & 6 Broker

8 Research Object Repository
e-Lab Anatomy is Simple

e-Lab = **community** + work objects + methods for building work objects

A **research object** is a story about an investigation.

A **decision object** is a critical mass of evidence to support a decision.
e-Lab Activity at Manchester

• >100 person years of activity planned for next 3-5 years
  – Healthcare and Public Health
    • North West e-Health: 19 fte to 2012
    • Care Pathway Simulators: 6 fte to 2013
    • Obesity e-Lab: 3 fte to 2011
  – Biology, Chemistry, Social Science, other...
    • Taverna, myGrid & myExperiment: 16 fte 2012

• Ethos
  – Use open-standards, service oriented arch., simple APIs
  – All software freely available in open source
  – Contribute to & learn from global family of innovation
Standards-based Health Information Systems

e-Lab: Sense-Making Layer

Care  Service Development  Research

Open Source Projects Sustained by the Value they Add through Crowd-Wisdom + Cloud Resources Shared

Powerful Models Agile Communities

Standards-based Health Information Systems
Conclusion

Vision: Global Network of e-Health e-Labs

– Sharing data, expertise & computational resources
– Free, open-source sense-making layer built on top of standards-based healthcare IT

– Innovation is local
– Inspiration is global
– Let’s keep talking