Public Health e-Labs for a Global Digital Economy

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OPEN ACCESS
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

Month of measurement by Health Visitor

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)

- Finance
- Clinical
- Public Health
- Research

Health District Data Tomb

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

Structured Data

Organise

Structured Data & Metadata

Transform & Examine
Audit; Research; Intelligence

Unclear Public Good

Health Records

Depersonalise

Research & Decision Objects

e-Lab for a defined community

Local Ownership

Asset Enrichment

Clear Public Good

Health Records
Deaths, Demographics etc.

Link on NHS number

Optometrist
Eye screening
Community nurses
Podiatry

Real-time
Data Repository in PCT

24-hourly updates
Anonymised Data Repository in PCT

Patient-driven information into records

Person-identifiable and sensitive information removed

Trusted person poses question(s)

FIREWALL

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.
Dataset → Digital Commodity

Serving health communities with high-quality health intelligence requires **metadata** from **local uses**...
Excellent research by-products of excellent service development

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

Care improvement or case-mix change?
Physical Activity

Diet

Smoking

Deprivation

Physical Activity

Diet

Smoking

Deprivation

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

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

\[ C = \sigma^2(I + ABB^T) \]

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
Localising Evidence Needs PHI

Future Population Impact Numbers

Current Population Impact Numbers

WHO Infobase
GloboCan

Risk exposure trends
Tumour registries

Interpretation & Report

Meta-analysis

Systematic review

Protocol

Rising complexity & computational cost
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 \(\rightarrow\) 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

5

NWCIS Registry

5

5. Per request keyed pseudonymisation

Repository

5. Per request keyed pseudonymisation
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
Open Source Projects
Sustained by the Value they Add
through Crowd-Wisdom
+ Cloud Resources Shared
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