Fuelling cycles of improvement with data in learning health systems

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Health eResearch Centre (HeRC)
The University of Manchester

King’s Fund Healthy Cities event, 17th July 2018
The landscape is changing ...

Traditional research data
- trials
- case-control studies
- cohort studies

Omics data
- genome
- proteome

Routine care data
- disease registries
- administrative data
- electronic health records

Wearable sensors
- Wearable sensors

Smartphones
- symptoms
- GPS

Home based sensors
- weighing scales
- blood pressure monitors
- glucose meters
Breaking down barriers

real world

innovation

learning

research
Learning health systems

Health systems—at any level of scale—become learning systems when they can, continuously and routinely, study and improve themselves

Charles P. Friedman
Analogy: credit fraud detection systems

- Credit card companies routinely collect data on all credit card transactions
- They use data mining methods to create a “safety net” that issues early warnings when fraud is suspected
- The safety net
  - learns from every transaction
  - is continuously updated
  - varies by region/country
  - is fully integrated with services
The learning health cycle

Flynn et al., Learn Health Sys. 2018;2:e10054.
Learning health system principles

• use every opportunity to learn
  exploit all the available data

• continuous learning
  permanent improvement efforts

• all-inclusive
  cuts across sectors of the health service

• integrated with services
  knowledge is brought to practice immediately
Connected Health Cities

- 2016 – 2020
- £20m
- Four regions (North England)
- One coordinating centre

Objectives:

- produce actionable information from health data
- civic partnership to use health data for service redesign
- accelerate digital health innovation in the NHS

https://www.connectedhealthcities.org
The Ark: Learning health system infrastructure

2015: Dilute, Duplicated Data Processing

- Raw Data
- Literature
- Policies
- NHS Commissioning
- NHS Quality Intelligence
- Public Health Intelligence
- Social Care Management
- Research and Innovation

Extract, clean, describe x 5

One size fits all

2020: Ark Integrated Data Processing

- Raw Data
- Literature
- Policies
- Ark
  - Targeting System
  - Public Involvement
  - NHS Commissioning
  - NHS Quality Intelligence
  - Public Health Intelligence
  - Social Care Management
  - Self-care and Personal Health
  - Combinatorial Research and Innovation

Extract, clean, describe x 1

Transparent Interface with Industry
CHC Care pathway projects

North West Coast
- Alcohol misuse
- Preventing unscheduled care in COPD

Connected Yorkshire
- Urgent and emergency care
- Healthier child growth
- Self-management care for frail older people

North East & North Cumbria
- Dementia and frailty
- Troubled families
- Forecasting emergency unplanned care

Greater Manchester
- Antibiotic prescribing
- Stroke
- Wound care
- Medication safety

For details see www.connectedhealthcities.org
Our work with Citizens Juries

- Comprehensive engagement processes that allow decision makers to hear thoughtful input from an informed microcosm of the public
- 2 juries (17 jurors each) met separately over 3 days
- **Jury charge**: “Should the NHS be allowed to create anonymised copies of patient records for secondary use?”

Tully et al., J Med Internet Res. 2018;20(3):e112.
What our jurors said

<table>
<thead>
<tr>
<th>Jurors Moved</th>
<th>Jurors in Initial Location</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 from A to B</td>
<td>6 and stayed here</td>
<td>A. Yes, but they should publish information</td>
</tr>
<tr>
<td>2 from B to A</td>
<td>1 and stayed here</td>
<td>B. Yes, but they should publish information + opt out</td>
</tr>
<tr>
<td>5 from C to B</td>
<td>1 and stayed here</td>
<td>C. Yes, but they should publish information + opt in</td>
</tr>
<tr>
<td>1 staying here</td>
<td></td>
<td>D. No</td>
</tr>
<tr>
<td>1 staying here</td>
<td></td>
<td>E. Other</td>
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Innovative IT system that prevents prescription errors wins prestigious national prize

Richard Williams, a Senior Software Engineer at The University of Manchester, based in the NIHR Greater Manchester Patient Safety Translational Centre (Greater Manchester PSTRC) and Centre for Health Informatics, has been awarded the respected John Perry Prize by BCS: The Chartered Institute for IT.

Announced at a glitzy ceremony in early October, the prize recognises Richard’s outstanding contribution to Primary Care Computing. Having been awarded annually since 1985 it is one of the IT industry’s most respected accolades, acknowledging innovation and excellence in computer science.

The Prize along with £500 cash was awarded in recognition of Richard’s work developing and disseminating the Smart Medication Safety Dashboard (SMASH). This potentially life-saving piece of software, which was developed with support from the Greater Manchester PSTRC and Health eResearch Centre (HeRC), was created to improve patient safety by reducing the number of prescription errors. Such errors occur in 5% of prescriptions according to a recent study of English general practices with one in 550 considered to be life-threatening.
Medication errors in primary care

Over 2.7 million prescription items are issued in primary care in England each day (or over 1,900 items every minute)

**Prescribing error**
Error in 4.1% medication items

- Prescribe medication
- Dispense or supply medication
- Administer medication
- Monitor effects

**Dispensing error**
Error in 3.3% of medication items

**Administration error**
Non-adherence 30-50% patients
Administration error = 8.4% (nursing homes)

**Monitoring error**
14.7% of medication items (nursing homes)
0.9% of medication items (GP)

NIHR Greater Manchester
Patient Safety Translational Research Centre
Prescription of NSAID to patients with CKD

Prescription of Digoxin to patients with a history of heart failure

Prescription of warfarin without an up to date INR

Prescription of oral or transdermal oestrogen without a progestogen in a woman with an intact uterus

Bupropion prescribed to a patient with epilepsy

SMASH

Identify patients with target disease
Example: CKD

Exclude if quality standard inappropriate
Example: Terminal illness

Evaluate against safety standard
Example: NSAID prescribed

Identify how care could be improved
Example: Change Rx

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Salford Clinical Commissioning Group
Salford Integrated Record
234k popln.

Web Interface
Practice-level Audit
Patient-level Decisions

44 GP Practices + 1 Hospital
GPs, pharmacists, CCG staff

NIHR Greater Manchester
Patient Safety Translational Research Centre
CCG view: atlas tool

Health Atlas - SMASH Forecasts

Prevalence: CKD and NSAID: 01 May 18
St. Elsewhere Medical Practice
1.37 proportion %

NIHR Greater Manchester
Patient Safety Translational
Research Centre
<table>
<thead>
<tr>
<th>Indicator</th>
<th>Affected patients</th>
<th>% of eligible patients affected</th>
<th>CCG Avg (%)</th>
<th>New cases</th>
<th>Trend</th>
<th>Show on top</th>
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</table>
Patients with a history of asthma who have been prescribed a β blocker

What is the risk to patients?

In susceptible patients β blockers can precipitate acute attacks of bronchospasm or worsen daily symptoms resulting in mortality or low grade morbidity respectively. The BNF advises that "β blockers should be avoided in patients with a history of asthma or bronchospasm; if there is no alternative, a cardioselective β blockers can be used with extreme caution under specialist supervision. Atenolol, bisoprolol, metoprolol, nebivolol, and (to a lesser extent) acebutolol, have less effect on the β2 (bronchial) receptors and are, therefore, relatively cardioselective, but they are not cardiосpecific. They have a lesser effect on airways resistance but are not free of this side effect". The Committee on Safety of Medicines\(^1\) issued the following advice: "...β blockers, even those with apparent cardioselectivity, should not be used in patients with asthma or a history of obstructive airways disease, unless no alternative treatment is available. In such cases the risk of inducing bronchospasm should be appreciated and appropriate precautions taken."

What evidence is there that this pattern of prescribing is harmful?

β blockers vary in their affinity for β₁- and β₂-adrenoceptors, and are divided into two groups, cardioselective (affinity for β₁), and non-cardioselective (affinity for β₂). The majority show little selectivity for one receptor over the other, except for bisoprolol (14-fold greater affinity for β₁-adrenoceptors) and timolol, sotalol and propranolol (26-fold, 12-fold, and 8-fold greater affinity for β₂-adrenoceptors, respectively).

<table>
<thead>
<tr>
<th>Table 1: Cardioselective and non-cardioselective beta-blockers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cardioselective beta-blockers (relative selectivity for β₁-adrenoceptors)</strong></td>
</tr>
<tr>
<td>Acebutolol (2.4)</td>
</tr>
</tbody>
</table>
Number of affected patients over time

Start date: 1 May 2013
End date: 1 May 2015

2014-07-01
- Age≥75 ACEI/LOOP no U&E: 8
- Age≥65 no GP and NSAID: 0
What do users say

“I think the main benefit is that it’s just how quick and easy it is to access these patients. Running searches on the GP clinical system is a nightmare.” (pharmacist)

“We want our pharmacist to look at the new initiations. Then she is going to send a message to the prescribing doctor that that's a high risk prescribing area and then leave it to the doctor to decide whether to action it or not.” (GP manager)

“Having this tool depersonalises feedback. [...] It’s not ... you know, you’ve done this and I don’t think it’s safe ... it’s the system that has picked this up.” (pharmacist)
Summary

- Learning health systems are health systems that continuously and routinely study and improve themselves.
- They aim to capitalise on opportunities that are provided by the data revolution – as has happened in other industries.
- They pose new challenges and reinvigorate old questions about:
  - interdisciplinary collaboration
  - real-world data
  - public-private partnerships
  - privacy and trust
Thank you

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