Monitoring the performance of cardiac surgeons

Graeme L Hickey\(^1\); Stuart W Grant\(^2\); Camila Caiado\(^3\); Iain Buchan\(^1\); Ben Bridgewater\(^{1,2}\)

\(^1\)Northwest Institute of BioHealth Informatics, Manchester University
\(^2\)Department of Cardiothoracic Surgery, University Hospital of South Manchester
\(^3\)Department of Mathematical Sciences, Durham University
Background

- Around 35,000 adult cardiac surgery procedures performed each year in UK
- Mortality rate in 2010-11 was 3.4%
- Monitoring primarily focuses on in-hospital mortality
Learning from Bristol:
The Department of Health's Response to the Report of the Public Inquiry into children's heart surgery at the Bristol Royal Infirmary 1984-1995

Presented to Parliament by the Secretary of State for Health by Command of Her Majesty
January 2002

Cardiac surgery performance in the spotlight

Mortality data in adult cardiac surgery for named surgeons: retrospective examination of prospectively collected data on coronary artery surgery and aortic valve replacement

Ben Bridgewater on behalf of the adult cardiac surgeons of north west England


Cite this as: BMJ 2005;330:506

Mortality data in adult cardiac surgery for named surgeons: retrospective examination of prospectively collected data on coronary artery surgery and aortic valve replacement

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Today’s monitoring programme

- National and local-level audits
- Revalidation
- Dr. Foster Health
- FOI requests
The framework

Cardiac surgery

Input data locally

Uploaded periodically to central database

Aim: <1 year  
Reality: 3 years

CQC website

National audit

Statistician + clinicians

Aim: 3 months  
Reality: 1 year

The Society for Cardiothoracic Surgery in Great Britain & Ireland
Sixth National Adult Cardiac Surgical Database Report 2008
Demonstrating quality
Prepared by Ben Bridgewater PhD FRCS, Bruce Keogh KBE DSc MD FRCS FRCP on behalf of the Society for Cardiothoracic Surgery in Great Britain & Ireland, Robin Kinsman BSc PhD, Peter Walton MA MB BChir MBA, Dendrite Clinical Systems
Risk adjustment

• Not all surgeons do the same caseload

- NHS surgeon
- Does emergency surgery
- Specialism in mitral valve repairs

- Does a lot of private surgery
- Mostly routine elective isolated bypass

Crude mortality = 6.1%
Risk-adjusted mortality = 3.1%

Crude mortality = 1.4%
Risk-adjusted mortality = 2.9%

Need to risk adjust!
Modelling

• Model for 1999-2012: EuroSCORE
  – Logistic regression
  – estimated using prospectively collected during 1995
  – In-hospital mortality (binary) outcome
  – Adjustment for 18 risk factors

• Replaced in 2012 by a contemporary model: EuroSCORE II
Monitoring methodology

• Funnel plot
  – Fixed summary over 3 years of data
  – Helps identify ‘outlier’ units
  – Doesn’t address whether hospitals are getting worse

• Variable life adjusted display (VLAD) plot
  – Intuitive dynamic summary
  – Doesn’t identify when a unit is an outlier
Funnel plot

All elective & urgent cardiac surgery in England & Wales

warrants closer investigation
Variable Life-Adjusted Display plot for an individual surgeon

The tipping point

The intervention

The Society for Cardiothoracic Surgery in Great Britain & Ireland
Maintaining patients' trust: modern medical professionalism
Outlier ≠ poor performance

• An ‘outlier’ surgeon or hospital (good or bad) might be explainable

   - Missing data
   - Input software errors
   - Registry cleaning errors
Question: What’s wrong with this?
Answer: Model over predicts mortality

Predicted mortality 2.7x greater than observed mortality!
Dynamics of cardiac surgery

- **Observed mortality is decreasing**
  - better surgical tools
  - improvements in post-surgery treatment
- **Predicted mortality is increasing**
  - increase in older patients
  - more complex procedures
Dynamics of risk

North-South divide?
Patching the problem: short-term

- Update the standard model
  - recalibration
  - model re-fit
  - shrinkage
- Adopt new model
  - requires validation
- Subgroup analyses
  - should some procedures be excluded from monitoring?
  - a statistical + political grey-zone
Patching the problem: long-term

- Better modelling approaches
- Online ‘live’ audit reporting + database querying
Dynamical modelling

• **Problem**: need a model that stays contemporary

• **Some possible solutions**:
  – do *nothing*
  – develop a *new model* every $x$-years
  – a *moving window* recalibration or re-fit
  – dynamic generalized linear modelling (*DGLM*)
DGLM

Model coefficients (log-odds)

- **Model 1**: Recalibration (single)
- **Model 2**: Piecewise recalibration
- **Model 3**: Window
- **Model 4**: DGLM

**Patient-related factors**

- Age (adjusted)
- Female
- Pulmonary disease
- Extracardiac arteriopathy
- Neurological dysfunction
- Previous surgery
- Creatinine > 200 mumol/l
- Active endocarditis
- Critical pre-op
DGLM

- The largest change is coming from intercept
- Latent variables affecting risk?
- Doing nothing is not an option
- Acting periodically might be too late

<table>
<thead>
<tr>
<th>Interceptor</th>
<th>2004</th>
<th>2006</th>
<th>2008</th>
<th>2010</th>
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<td>Model 1: Re-fit</td>
<td>-5.8</td>
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</tbody>
</table>

![Graph showing time trends and coefficients for different models](image)
Online tools

NW&H e-lab

National Audits
Monitoring Tools
Database Querying
Summary

• Current infrastructure incompatible with developments in healthcare monitoring & surveillance

• Real-world data is not perfect which increases uncertainty + potentially a source of bias

• Modelling for contemporary cardiac surgery needs to adapt to changing dynamics
Any questions?

"Nurse, get on the internet, go to SURGERY.COM, scroll down and click on the 'Are you totally lost?' icon."