Improvement indicators for Quality & Safety in the UK

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Brian Jarman, FRCP, FRCGP, Emeritus Professor, Director Dr Foster Unit, Imperial College
Faculty of Medicine, London (b.jarman@ic.ac.uk)
Part-time Senior Fellow, IHI
Subjects to be covered

1. History of adverse events in hospitals
2. Methods used by UK hospitals to improving patient safety – web sites
3. Hospital Standardised Mortality Ratios (HSMRs) in the UK and elsewhere
4. Detecting possible problems early and evaluating improvement initiatives
5. Examples of the use of HSMRs and SMRs of diagnoses for improvement.
Web sites used in the UK

  ‘NHS Choices’ NHS public website

- http://www.nhs.uk/NHSEngland/Hospitalmortalityrates/Pages/Data.aspx#q03
  ‘NHS Choices’ NHS public website HSMRs

- http://www.drfosterhealth.co.uk/
  ‘Dr Foster’ public website

  ‘NHS Information Centre’ public website
Uniform hospital statistics would:

“Enable us to ascertain the relative mortality of different hospitals as well as of different diseases and injuries at the same and at different ages, the relative frequency of different diseases and injuries among the classes which enter hospitals in different countries, and in different districts of the same country”

Florence Nightingale 1863
Noted
“calamities of surgery or those accidents and complications over which we have no known control. These should be acknowledged to ourselves and to the public and study directed to their prevention”

"I had made an error of skill of the most gross character and even (during the operation) failed to recognize that I had made it".

His reforming attempts
“brought him mostly ridicule, poverty and censure”
Donabedian classified the elements of healthcare, and divided studies of its quality, into:

- **structure** - the building, equipment, and human and financial resources
- **process** - what happens to patients
- **outcome** - the final results achieved: the patient's health status as a result of treatment.

Outcomes important for the patient.
The healthcare patients require:

- **Timely**  ▶ available within a time period consistent with clinical need;
- **Patient centred**  ▶ the best choice of treatment with patient sharing in the decision;
- **Effective & Safe**  ▶ provides patient benefit, is safe, based on current evidence, avoids overuse and underuse
- **Efficient**  ▶ without waste
- **Equitable**  ▶ same quality care regardless of race, gender, wealth
Harvard Medical Practice study of New York state hospitals (NEJM 1991)

- 30,000+ randomly selected patients in New York State hospitals
- 3.7% had injuries from adverse medical care events
- 13.6% had led to death
- Half were preventable
- If Harvard figures apply to Japanese hospitals, implies >40,000 preventable deaths from adverse events medical care events each year.
Adverse event studies (adapted from Charles Vincent)
Approx: 50% avoidable, 8% result in death, 6% in permanent disability
Total 210 hospitals involved, 100,429 admissions
Weighted (by no. admissions) mean adverse event rate = 6.6% of admissions
For example: 8% of 5.7% of 1.6m IP admissions = 7,300 deaths annually, half avoidable

<table>
<thead>
<tr>
<th>Study</th>
<th>Number of hospitals</th>
<th>Date</th>
<th>Number of admissions</th>
<th>Adverse event rate (%)</th>
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<td>California Insurance Feasibility</td>
<td>23</td>
<td>1974</td>
<td>20,864</td>
<td>4.65</td>
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<tr>
<td>(The California study assessed 'potentially compensable' events)</td>
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<td>Harvard Medical Practice</td>
<td>51</td>
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<td>Utah-Colorado (UTCOS)</td>
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<td>Quality in Australian Health Care</td>
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<td>1992</td>
<td>14,179</td>
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<td>1998</td>
<td>1,097</td>
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<td>13</td>
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<td>6,579</td>
<td>11.2</td>
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<td>2</td>
<td>1999</td>
<td>1,014</td>
<td>10.8</td>
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<td>Canada</td>
<td>20</td>
<td>2000</td>
<td>3,745</td>
<td>7.5</td>
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<td>France (pilot only)</td>
<td>7</td>
<td>2002</td>
<td>778</td>
<td>14.5</td>
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<tr>
<td>Netherlands</td>
<td>21</td>
<td>2005-6</td>
<td>7,926</td>
<td>5.7</td>
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</table>
National Patient Safety Agency (NPSA)
Reported adverse event incident types in England Jul 07-Jun 08

- 805,299 incidents reported
- 32,605 Other
- 34,301 Disruptive, aggressive behaviour
- 35,692 Clinical assessment (including diagnosis, scans, tests, assessments)
- 42,462 Documentation (including records, identification)
- 55,165 Infrastructure (including staffing, facilities, environment)
- 28,635 Consent, communication, confidentiality
- 95,171 All other incident types
- 270,726 Patient accident
- 79,936 Treatment, procedure
- 71,612 Medication
- 58,994 Access, admission, transfer, discharge (including missing patient)
“So far as I know, all modern, effective systems to assure and improve safety involve a culture in which the reporting of error or apparent error is a valued and positive act, which leads, not to blame, but to curiosity and study.”

(Berwick DM. BMJ 1998;316:1925)
The Safety Triad (Finance, Healthcare etc).
Who has the power and who has the incentive to improve safety?

- The public
  - strong
- The practitioners
  - cosy
  - ‘light touch’
- The regulators
  - very weak
Bristol Royal Infirmary Inquiry

- Concerns regarding Bristol unit from 1986 led to an external Inquiry in February 1995
- All paediatric cardiac surgery was stopped until the appointment of another cardiac surgeon
- June 1996 parents’ group first called for a Public Inquiry into the PCS services at the BRI
- 1998 GMC trial led to disciplining of 3 doctors of whom 2 were struck off and 1 restricted
- 1999 to 2001 Bristol Inquiry
Bristol paediatric cardiac surgery: Number of concerns expressed per year about Bristol

- In October 1986, Professor Andrew Henderson, then Professor Emeritus, University of Wales, distributed a letter at a meeting of the South Glamorgan Health Authority (SGHA) stating ‘it is no secret that their surgical service is regarded as being at the bottom of the UK league for quality’.
- CMO Wales expressed concerns to Chief Medical Officer of England.
- New anaesthetist, Dr Bolsin, expressed repeated concerns - 1989 until 1995 both locally and nationally.
- External Inquiry.

- 16 June 1987 BBC Wales TV: ‘Heart Surgery - the 2nd class Service’.

Diagram showing the number of concerns expressed per year from 1986 to 1994.
Mortality rate for paediatric cardiac surgery, all open operations, aged under 1 year, Hospital Episode Statistics April 1991 to March 1995
Comparison of % open operations by age at surgery between Bristol and elsewhere (1 April 1991 to 31 March 1995) (Analyses by Nicky Best, Paul Aylin, Clare Marshall, Alex Bottle, David Spiegelhalter)
Bristol & England Paediatric Cardiac Surgery (under 1 year, open heart ops)
MORTALITY DROPPED FROM 27% TO 8% AFTER IMPROVEMENTS IN 1995
The Safety Triad (Finance, Healthcare etc).
Who has the power and who has the incentive to improve safety?

The public

Why didn’t you tell us?

The practitioners

The regulators

cosy
‘light touch’

very weak

strong
On 19 July 1994 the ‘whistle-blower’, an anaesthetist Dr Bolsin, gave the doctor at the Department of Health (DoH), who dealt with clinical outcomes, an envelope which contained data about the problems at Bristol.

The DoH doctor told the Inquiry that he did not look at the data. He put it away in a filing cabinet.

“The DoH, for historical and structural reasons, was simply unable adequately to respond when an issue of the quality of care was being raised”
The Safety Triad (Finance, Healthcare etc).
Who has the power and who has the incentive to improve safety?

The public

The practitioners

The regulators

Why didn’t You tell us?

Please don’t tell us!
• “The profession had very deep reservations about the Department getting involved [in matters of clinical performance]. Reservations which, to some extent, ... on rational grounds, the Department shared”.

• “... if Ministers might be tempted to tread down that path of involvement and intervention [in matters of clinical performance], then they could be pretty sure that there would be a tremendous row about it with the profession, and that is something which you certainly do not want to do without forethought”
“Bristol was awash with data. There was enough information from the late 1980s onwards to cause questions about mortality rates to be raised both in Bristol and elsewhere had the mindset to do so existed.”
At a national level there was confusion as to who was responsible for monitoring quality of care. The confusion was not, however, just some administrative game of ‘pass the parcel’. What was at stake was the health, welfare, and indeed the lives of children. What was lacking was any real system whereby any organisation took responsibility for what a lay person would describe as ‘keeping an eye on things’.
• “It appears therefore that a much higher proportion of the general public are concerned about the safety of healthcare than doctors.”
• “If healthcare was an airline, only dedicated risk takers, thrill seekers and those tired of living would fly on it.”
• “The medical profession, in the United States at least, seem curiously unaware of the hazards of the system they work in.”
‘is the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge’

The need for outcome measures

• Professor Michael Porter, Harvard, 2006:
  • “measuring outcomes is liberation, measuring process is servitude”

• Dr David Colin Thomé, UK, April 2009
  • A key lesson is that all organisations should be focused on prioritising high quality patient care as judged by outcomes, and whilst process targets are very helpful on the journey, they must not become a distraction from the bigger picture.
Why measure mortality? Advantages of death rates as measures of outcomes

- Death is a definite unique event (unlike morbidity which is continuous and difficult to record)
- Deaths must be recorded by law, hence are likely to be a complete and accurate record (this applies to death certificates, but will not necessarily apply to hospital administrative records)
- Does not mean that process should not be measured, but care needed when comparing hospitals (some hospitals are more vigilant)
Problems with morbidity measurement

- Measuring of the pre-operative condition
- Getting an agreed, universally recognised, measure and measurement methods that are consistent between units
- Bristol Inquiry: ‘…the better centres, that is, centres with a lower mortality in adult cardiac surgery, had a better record of rescue of the complications, that is, they recognised them earlier and treated them better, for the same severity score’
- Some evidence that hospitals with lower mortality rates tend to record a higher level of ‘adverse events’ ie they are more vigilant.
Hospital Standardised Mortality Ratio

Originally developed in UK in 1990s

Indirect standardisation or logistic regression using top 80 diagnoses leading to 80% of all in-hospital deaths and adjusted for diagnosis, age, sex, admission source, admission type (emergency/elective/urgent), LOS

Published by NHS on NHS Choices website 30.04.09

http://www.nhs.uk/NHSEngland/Hospitalmortalityrates/Pages/Data.aspx#q03
Example of indirect standardisation by age for one hospital
Sum of expected deaths = 540. Observed deaths = 600. HSMR=Obs/Exp x 100 = 110
Model at SMR level (c stat 0.91) adjusts for (* at HSMR level):

- age*
- sex*
- emergency status*
- socio-economic deprivation
- diagnosis (accounting for 80% of all in hospital deaths)*
- diagnosis subgroup (3 digit ICD10)
- co-morbidity – Charlson index
- number of prior emergency admissions
- palliative care
- year
- month of admission (for some respiratory diseases)
### English & Dutch Analyses: possible break down of the data by:

<table>
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<tr>
<th>Category</th>
<th>Example Details</th>
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<tr>
<td>GP Practice</td>
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<td>Intended management, Local Authority, LOS (0 or 1+), LOS (6 bands), LOS (national quarter), LOS (Post-op), LOS (Pre-op), LOS (s/s - national quarter)</td>
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<td>Procedure</td>
<td>Specialty (of admission), Specialty (of discharge), Specialty (of HRG), Specialty chapter, Specialty code</td>
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<td>Provider</td>
<td>Specialty type, Spell of superspell, Spells in superspell, Subgroup</td>
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<td>Team</td>
<td>Tariff (£), Team (of HRG), Team (of procedure), Team (on admission), Team (on discharge)</td>
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<td>Transfers</td>
<td>Transferee, Transferrer, Trend (Calendar Year), Trend (Financial Year), Trend (Month), Trend (Quarter)</td>
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<td>Waiting Time</td>
<td>Waiting Time, Ward (census)</td>
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</tbody>
</table>
Comparison of administrative & clinical databases

ROC curve areas comparing ‘simple’, ‘intermediate’ and ‘complex’ models derived from HES with models derived from clinical databases for four index procedures

Aylin P; Bottle A; Majeed A. Use of administrative data or clinical databases as predictors of risk of death in hospital: comparison of models. BMJ 2007;334: 1044
Comparison of administrative & clinical databases

Calibration plots for 'complex' HES-based risk prediction models for four index procedures showing observed number of deaths against predicted based on validation set

Aylin P; Bottle A; Majeed A. Use of administrative data or clinical databases as predictors of risk of death in hospital: comparison of models. BMJ 2007;334: 1044
## Countries for which HSMRs calculated

*green = monthly red = published with hospital names*

**Queries from:** France, Italy, Japan, Finland, Denmark, New Zealand, Germany, Hong Kong

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<td>Australia NSW</td>
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IOM report – Crossing the Quality Chasm & Bristol Royal Infirmary Inquiry Report
US HSMRs: Continental US vs 61 Hospitals outside US mainland, 57 in Puerto Rico & 4 others (North Mariana Islands, Guam, Virgin Islands, American Samoa)

IOM reports
Significant (p<0.001) associations were found between HSMR and the following questions in the National Survey of NHS Patients (with the poorer, more dissatisfied responses corresponding to higher mortality):-

- ‘If you had any anxieties or fears about your condition or treatment, did a doctor discuss them with you?’
- ‘If your family or someone else close to you wanted to talk to a doctor, did they have enough opportunity to do so?’
- ‘Did a member of staff explain the purpose of the medicines you were to take at home in a way you could understand?’
- ‘Did a member of staff tell you about medication side-effects to watch for when you went home?’
- ‘Would you recommend this hospital to your family and friends?’

Note: NHS Patient Survey asks specific questions eg: “How long did you wait?”; “Were you in pain?”; “How long in pain?”
Monthly warnings (alerts) of possible problems

- Normal administrative hospital data is collected for all English hospitals every month and analysed at Imperial College and Dr Foster Intelligence.
- For diagnoses and procedures covering 90% of all hospital deaths the ratio of the cumulative sum (CUSUM) of the log of the odds ratio of observed to expected deaths is calculated for each patient cumulatively.
- CUSUM charts are plotted and alerts noted: if significant at 99.9% level letter sent to Chief Executive of hospital from Imperial College.
CUSUM charts

• Based on log-likelihood (odds ratio) CUSUM to detect a predetermined increase in risk of interest
• Taken from Steiner et al (2000); pre-op risks derived from logistic regression of national data
• The CUSUM statistic is the log-likelihood test statistic for binomial data based on the predicted risk of outcome and the actual outcome
• Models adjust for age, sex, emergency status, etc.
• Chief Executives receiving an alert are required to take necessary action under Clinical Governance.
US: CUSUMs chart observed – expected deaths: hypertension & heart failure: 250 admissions over 2 years
Monitoring surgical performance using risk-adjusted cumulative sum charts

STEFAN H. STEINER*, RICHARD J. COOK
Department of Statistics and Actuarial Sciences, University of Waterloo, Waterloo,
Ontario, Canada N2L 3G1
shsteine@uwaterloo.ca

VERN T. FAREWELL
Department of Statistical Sciences, University College London, UK

TOM TREASURE
St. George’s Hospital Medical School London, UK

\[
W_t = \begin{cases} 
\log \left[ \frac{(1 - p_t + R_0 p_t)R_A}{(1 - p_t + R_A p_t)R_0} \right] & \text{if } y_t = 1 \\
\log \left[ \frac{1 - p_t + R_0 p_t}{1 - p_t + R_A p_t} \right] & \text{if } y_t = 0
\end{cases}
\]
US CUSUM chart - log (likelihood or odds ratio): hypertension & heart failure: 250 admissions over 2 years

cusum of patient cusum statistic (log likelihood or odds ratio) score set to detect odds ratio of 2 (based on Steiner et al)

trigger value = 5
**England: Mortality warnings/alerts**

- Sent monthly from Imperial College to CEO of any acute hospital trust in England alerting them if they have an SMR with less than 1 in 1000 chance (99.9% CI) that it is double the national death rate over previous 12 months
- Copied to Healthcare Commission (now CQC)
- 78 diagnoses, 128 procedures, 90% deaths
- To Chief Executive, copy Medical Director
- Note could be due to:
  - Poor coding
  - Inadequate case-mix adjustment
  - Quality of care
“The Healthcare Commission is empowered by section 52(1) of the Health and Social Care (Community Health and Standards) Act 2003 to conduct investigations into the provision of healthcare by or for an English NHS body. We usually investigate when allegations of serious failings are raised, particularly when there are concerns about the safety of patients… In investigating allegations of serious failings in healthcare, we aim to help organisations to improve the quality of care they provide, to build or restore public confidence in healthcare services, and to seek to ensure that the care provided to patients is safe throughout the NHS.”
Example of monthly warning/alerts: diagnosis = Acute MI
Example of monthly warning/alert:
procedure = plastic repair of aortic valve

• “The Healthcare Commission has also recently received a number of concerns from individual patients and relatives, about standards of care at ward level.”

• “The Healthcare Commission is therefore launching an investigation at Mid Staffordshire NHS Foundation Trust.”

• “The trust’s data on outcomes for patients has also recently caused the Dr Foster Unit at Imperial College London to bring concerns to the attention of the trust and the Healthcare Commission.”

*The aim is to avoid the need for a publicised investigation*
“The SHA [Strategic Health Authority] was not aware of any concerns regarding the quality of services provided by the trust before Dr Foster Intelligence published its Hospital Guide in April 2007.”
“The [Healthcare] commission became aware of high mortality rates for specific conditions or operations at this trust during the summer of 2007, through its routine analysis and statistics known as hospital standardised mortality ratios, or SMRs, produced by the Dr Foster research unit, based at Imperial College”

Hansard 18 Mar 2009 : Column 233
Some of the problems at Mid Staffordshire.
Professor Sir George Alberti. 29 April 2009

- Understaffing of A&E - too few consultants, middle-grade doctors and nurses
- Initial patient assessment by untrained receptionists
- Poor supervision of junior doctors
- Weak leadership of nurses and inadequate nurse training
- Poor equipment in A&E
- Long delays and tendency to move patients to the Emergency Assessment Unit (EAU), Clinical Decision Unit (CDU) and “assess and treat” area in order to meet the 4 hour target before they had been investigated or any diagnosis made
- Lack of protocols and clear pathways
- Chaotic, large, understaffed EAU with little training for the nurses
- Poorly equipped EAU.
- Poor handover from EAU to medical and surgical wards
- Insufficient beds for coronary care or strokes
- Major delays for emergency operations
- Inadequate numbers of experienced surgeons with poor 24/7 cover
- Poor post-operative care
- Very poor patient care on the medical and surgical wards
- Inadequate handling of patient complaints
“Hospital standardised mortality ratio

The hospital standardised mortality ratio (HSMR) is a comparative measure of an acute trust's overall mortality developed by the Dr Foster Research Unit. It does not cover all admissions, but focuses on a group of diagnoses that accounts for 80% of all deaths in hospitals in England. The HSMR accounts for the case mix of patients at the time they are admitted to the trust, adjusting for a number of factors that include the primary diagnosis, age, sex, ‘comorbidities’, deprivation and method of admission... A value for the HSMR of 100 indicates mortality that is equivalent to what would be expected, given the case mix. Values greater than 100 indicate higher than expected mortality, and values less than 100 indicate lower than expected. In the 2007 Dr Foster Hospital Guide, the trust was classified as having high mortality, with a one-year (2005/06) HSMR of 127 and a three year (2003-2006) HSMR of 125.”
“Dr Foster Intelligence real-time monitoring system

The real-time monitoring system produced by Dr Foster Intelligence uses standardised methodologies (designed by Professor Sir Brian Jarman and Dr Paul Aylin) to allow trusts to compare their clinical outcomes against all other acute trusts in England, and against a local peer group. The system is also able to monitor outcomes for specific consultant teams, and by specialty. Where a significant divergence in a clinical outcome is detected, an automated alert is produced.”
HSMRs, monthly warnings/alerts, Healthcare Commission

- The warnings are sent confidentially
- The Healthcare Commission has other information eg patient complaints
- The Healthcare Commission can inspect and give improvement advice
- The problems at Bristol need not occur
Examples of use of HSMRs and SMRs for improvement

- Bolton Hospital - fractured neck of femur (fractured hip)
- Northwest London Hospital – a hospital that had had problems
- Walsall Hospital – had the highest HSMR in 2001
- US hospitals – Owensboro, Tallahassee, Missouri Baptist, Henry Ford

• “Delay in operation was associated with an increased risk of death in hospital, which was reduced but persisted after adjustment for comorbidity.”

• Bolton also appointed orthopaedic geriatricians
Bolton Hospital # NOF actions

• Reduced time to theatre in medically unfit patients to a mean of 3 days

• Overall time to theatre reduced by 30%

• Length of stay reduced by 32%

Mortality (in-hospital) | Diagnoses | Fracture of neck of ...r (hip)

Intervention

CUSUM Statistic - Negative

Date of discharge

Apr-04 (2)  Sep-04 (166)  Feb-05 (340)  Aug-05 (607)  Jan-06 (886)  Jul-06 (1857)  Feb-07 (1025)  Jul-07 (1188)  Jan-08 (1346)  Jul-08 (1508)
Bolton: Cusum reduction of Obs – Exp deaths # NOF compared with expected if Q1 2005 death rate continued

Looked up the 25 main causes of death

Targeted eight areas for care bundles

- Stroke
- COPD
- Heart failure
- MRSA
- C Diff
- CVP
- VAP
- SSI

Actually achieved 256 fewer deaths (in the HSMR diagnoses) [data from Liz Todd, NWLH]
Reducing avoidable mortality (from Liz Rob NWLH)

Example of a care bundle - central venous catheter
North & West London – cusum chart showing improvement starting in April 2007: 56 HSMR CCS diagnoses
North & West London – cusum chart showing improvement starting in April 2007: Stroke

Mortality (in-hospital) | Diagnoses | Acute cerebrovascular disease

CUSUM Statistic - Positive

Date of discharge
North & West London – cusum chart showing improvement starting in April 2007: Pneumonia

Mortality (in-hospital) | Diagnoses | Pneumonia

CUSUM Statistic - Positive

Date of discharge

Apr-05 (1)
Nov-05 (542)
Jul-06 (1130)
Feb-07 (1637)
Oct-07 (2155)
May-08 (2870)
North & West London – cusum chart showing improvement starting in April 2007: UTIs
North & West London Hospitals Trust HSMRs (England = 100 every year)

Improvement campaign:
8 areas using care bundles
Funnel plot showing change of NWLH HSMR 2006-7 to 2007-08

HSMRs 2007/08: NWLH 2006/07 HSMR shown with blue diamond, 2007-08 HSMR with red diamond
(all HSMRs use year 2007/08 England HES data as reference baseline)
• Observed – Expected deaths 2007-08 if the trusts had had the 2006-07 HSMR in 2007-08:
  • Non-targeted diagnoses = -68
  • Targeted diagnoses = -174
  • All HSMR diagnoses = -255
## NWLH Summary of mortality reduction from 2004-05
**Observed – Expected deaths if had 2004/05 HSMR each year**

<table>
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<tr>
<th>Year</th>
<th>HSMR</th>
<th>Deaths</th>
<th>Expected</th>
<th>Deaths if 2004/05 HSMR had applied</th>
<th>Difference from observed deaths</th>
<th>Cusum difference from observed deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004/05</td>
<td>116.7</td>
<td>1,446</td>
<td>1,240</td>
<td>1,446</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2005/06</td>
<td>100.9</td>
<td>1,241</td>
<td>1,230</td>
<td>1,435</td>
<td>-194</td>
<td>-194</td>
</tr>
<tr>
<td>2006/07</td>
<td>89.7</td>
<td>1,142</td>
<td>1,274</td>
<td>1,486</td>
<td>-344</td>
<td>-538</td>
</tr>
<tr>
<td>2007/08</td>
<td>71.0</td>
<td>976</td>
<td>1,375</td>
<td>1,604</td>
<td>-628</td>
<td>-1,166</td>
</tr>
</tbody>
</table>
Walsall Hospital NHS Trust had the highest HSMR (130) in England when data first published on 21 January 2001. Initially questioned data extensively. Queries regarding hostels and management of stroke by GPs in the area. Eventually decided to accept data and implement wide range of changes.
The Walsall Clinical Governance Structure (Dr Mike Browne)

Trust Board

Clinical Governance Assurance Committee

Clinical Governance Committee

Clinical Governance Teams

Clinical Audit
Clinical Effectiveness
Education & Training
Information
Risk Management
Staffing & Staff Management
Patient & Public Involvement

Clinical Governance Groups

Surgery
Obs & Gynae
Paeds
Elderly Care
General Medicine
Theatre, Critical Care, A&E, OPD
Professional Clinical Services

Top Management Team
(one member chairs each of the 7 CG committees)
Walsall change of HSMR – intervention started in 2001
Walsall HSMR cusum analysis – intervention started after HSMRs published Jan 2001
Walsall annual death rate for HSMR diagnoses

![Crude annual death rate graph for HSMR diagnoses](image-url)
Walsall CUSUM actual annual actual deaths - deaths expected at 2000 crude death rate for HSMR diagnoses
Owensboro medical Health System, Owensboro, KY

2004 mission driven strategic planning improvement process started
TALLAHASSEE MEMORIAL HEALTHCARE
regression-adjusted HSMRs - 2002 interventions started

USA HSMRs (year 2000=100)
- TALLAHASSEE MEMORIAL HEALTHCARE lower 95% CI
- TALLAHASSEE MEMORIAL HEALTHCARE upper 95% CI
- TALLAHASSEE MEMORIAL HEALTHCARE HSMRs
MISSOURI BAPTIST MEDICAL CENTER, regression-adjusted HSMRs
Henry Ford hospital, non-regression adjusted HSMRs
Imperial College
London

London Teaching Hospital Trusts* - circulatory diseases SMRs
(England = 100 each year)
Source: B. Jarman, Dr Foster Unit, Faculty of Medicine, Imperial College London. Based on NES data

Primary angioplasty for MI about here

*St Mary’s, St George’s, King’s College Hosp, Guy’s & St Thomas’, Royal Free, UCL, Barts & The London, Chelsea & Westminster
London Teaching hospitals*, Circulatory diseases
CUSUM Observed - Expected deaths from 1996 to 2007
Comparison with expected deaths based on England overall as norm

Source: B. Jarman, Dr Foster Unit, Faculty of Medicine, Imperial College London. Based on HES data

* St Mary's, St George's, King's College Hosp, Guy's & St Thomas', Royal Free, UCL, Barts & The London, Chelsea & Westminster, Hammersmith