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Date of publication

This guide was published in 2010 and will be reviewed in 2012. The latest version will always be available online on the programme’s website: www.1000livesplus.wales.nhs.uk

The purpose of this guide

This guide has been produced to enable healthcare organisations and their teams to successfully implement a series of interventions to improve the safety and quality of care that their patients receive.

Further ‘Tools for Improvement’ guides are also available to support you in your improvement work:

- How to use the Extranet
- A Guide to Measuring Mortality
- Improving Clinical Communication using SBAR
- Using Trigger Tools
- Reducing Patient Identification Errors

These are available from the 1000 Lives Plus office, or online at www.1000livesplus.wales.nhs.uk

We are grateful to The Health Foundation for their support in the production of this guide.
Improving care, delivering quality

The 1000 Lives Campaign has shown what is possible when we are united in pursuit of a single aim: the avoidance of unnecessary harm for the patients we serve. The enthusiasm, energy and commitment of teams to improve patient safety by following a systematic, evidence-based approach has resulted in many examples of demonstrable safety improvement.

However, as we move forward with 1000 Lives Plus, we know that harm and error continue to be a fact of life and that this applies to health systems across the world. We know that much of this harm is avoidable and that we can make changes that reduce the risk of harm occurring. Safety problems can’t be solved by using the same kind of thinking that created them in the first place.

To make the changes we need, we must build on our learning and make the following commitments:

■ Acknowledge the scope of the problem and make a clear commitment to change systems.
■ Recognise that most harm is caused by bad systems and not bad people.
■ Acknowledge that improving patient safety requires everyone on the care team to work in partnership with one another and with patients and families.

The national vision for NHS Wales is to create a world-class health service by 2015: one which minimises avoidable death, pain, delays, helplessness and waste. This guide will help you to take a systematic approach and implement practical interventions that can bring that about. The guide is grounded in practical experience and builds on learning from organisations across Wales during the 1000 Lives Campaign and also on the experience of other campaigns and improvement work supported by the Institute for Healthcare Improvement (IHI).
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In the United Kingdom, the review of case notes from single study sites suggests that 10% of patients experience an adverse event during in-patient management. Similar findings have been reported from studies in the US, Europe and Australia.\(^1\)\(^-\)\(^7\) A recent systematic review of international studies attempted to gain an overview of data and quantification of what is widely recognized as a ‘serious problem in healthcare’.\(^8\)

The median overall incidence of in-hospital events was 9.2%, with a median percentage of preventability of 43.5%. More than half of these patients experienced no or minor disability and 7.4% were lethal. Whilst single site and summary data is undoubtedly useful, the data highlights that medical injuries are context specific, can happen during all stages of the complicated process of care and can vary widely in nature.\(^9\) From these studies we can infer that avoidable mortality is occurring in hospitals within Wales.

Avoidable mortality can be described as deaths that should not occur given current medical knowledge and technology.\(^10\) The recognition that some preventable harm is occurring to patients, which can result in death, has led to a variety of methods that attempt to quantify mortality levels.

### Measuring mortality in hospitals

There are a variety of methods for measuring mortality in hospitals, each have their advantages and disadvantages. When used appropriately they can provide an organisation with valuable insights about to areas for improvement.

#### Case note reviews

One method for determining the levels of avoidable mortality in hospitals is to undertake case reviews of all deaths. This direct method of investigating deaths is beneficial to provide incidence of any failings and learning from errors occurring.

The Welsh Assembly Government has requested that all hospitals undertake weekly case note reviews on all deaths. The following are a list of useful resources which can help you undertake a case note review of in hospital deaths.

- A Matter of Life and Death: Increasing reliability and quality to reduce hospital mortality and improve end of life care. Modernisation Agency NHS; 2004. (The original guidance issued by 1000 Lives Campaign as the method for undertaking case note reviews for deaths)
- Reducing avoidable deaths (Medical Directors). NHS Institute for Innovation and Improvement, June 2007.
As well as direct measures of mortality such as case note reviews, there are a series of outcome proxy measures which can assist hospitals monitor mortality levels over time. Crude mortality is one such method.

### Crude Mortality Rate

The simplest method is crude mortality rate:

\[
\text{Crude Mortality Rate} = \frac{\text{Number of deaths in a specified period}}{\text{Average total population during that period}} \times 10^N
\]

The advantage of using this method is that the calculation is easy for individuals to follow, and easier for front-line clinical staff to measure. Therefore, it is more likely to have local ownership. The main disadvantage of this method is that it does not take into account age, sex, race, socio-economic, and other factors.

A crude mortality rate measures all deaths and does not attempt to quantify avoidable death. In contrast, risk-adjusted mortality measures attempt to quantify levels of avoidable mortality.

### Risk-adjusted mortality measurement

A proxy measure for estimating avoidable mortality in hospitals is a case-mix adjusted mortality rate. Such measures attempt to adjust for the variables which impact on the chance of dying. The basic concept of risk-adjusted mortality measurement is not new, and was demonstrated by Florence Nightingale's work in London hospitals.

Two examples of risk-adjusted morality measurement used in practice in the UK include Risk-Adjusted Mortality Index (RAMI) and Hospital Standardised Mortality Ratio (HSMR).

### Risk-Adjusted Mortality Index (RAMI)

RAMI was developed by Susan DesHarnais in the 1990s to measure the risk of death during a hospital stay for specific diagnoses and procedures. Predictive variables used within this logistic regression model include the patient’s age, gender, race, diagnosis related groups, presence or absence of co-morbidity, presence of any secondary diagnosis. RAMI is a quality improvement measure which allows hospitals to investigate deaths and make improvements over time.

Within the UK, RAMI is the method for measuring mortality developed by Caspe Healthcare Knowledge Systems (CHKS). When a patient is admitted to any hospital in England or Wales the attributes of that patient are recorded on the CHKS system, which uses a statistical model to calculate the probability of death.
for that patient (RAMI model). The data is summarised monthly to show for each Health Board and Trust the number of observed deaths, expected deaths and the RAMI.

A mortality index is a ratio of an observed number of deaths to an expected number of deaths in a particular population. This index is used to make normative comparisons and is standardised in that the expected number of events is based on the occurrence of the event in a normative population.

The normative population used to calculate expected numbers of events is selected to be similar to the comparison population with respect to relevant characteristics including age, sex, region, and case-mix.

The index is simply the number of observed events divided by the number of expected events. Interpretation of the index relates the experience of the comparison population relative to a specified event to the expected experience based on the normative population.

**Examples**

<table>
<thead>
<tr>
<th>Events Observed</th>
<th>Expected Events</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 events observed</td>
<td>10 events expected</td>
<td>The observed number of events is equal to the expected number of events based on the normative experience.</td>
</tr>
<tr>
<td>10 events observed</td>
<td>5 events expected</td>
<td>The observed number of events is twice the expected number of events based on the normative experience.</td>
</tr>
<tr>
<td>10 events observed</td>
<td>25 events expected</td>
<td>The observed number of events is 60% lower than the expected number of events based on the normative experience.</td>
</tr>
</tbody>
</table>

Therefore, an index value of 1.0 indicates no difference between observed and expected outcome occurrence. An index value greater than 1.0 indicates an excess in the observed number of events relative to those expected based on the normative experience.

An index value less than 1.0 indicates fewer events observed than would be expected based on the normative experience. An additional interpretation is that the difference between 1.0 and the index is the percentage fewer or excess events relative to the norm.

In other words, an index of 1.05 indicates 5% more deaths and an index of 0.90 indicates 10% fewer deaths than expected based on the experience of the norm. The index can be calculated across a variety of groupings, e.g. hospital, specialty, HRG, and consultant.
**Hospital Standardised Mortality Ratio (HSMR)**

HSMR is an example of a quality improvement measure that allows hospitals to investigate deaths and make improvements over time. The HSMR measure was originally developed by Sir Brian Jarman at the Imperial College in London and is now used by hospitals in several countries to identify strategies for reducing deaths, to monitor changes in performance and ultimately to strengthen quality of care.14

In each country, the methods used are similar, but HSMR results are calibrated based on the national mortality experience. For example, the diagnosis groups included may differ from country to country.15

The case-mix adjusted mortality ratio is calculated as a ratio of the actual number of deaths to the expected number of deaths among patients in acute hospitals.

\[
\text{HSMR} = 100 \times \frac{\text{Observed Deaths}}{\text{Expected Deaths}}
\]

Like RAMI, a ratio equal to 100 suggests that there is no difference between the hospital’s mortality rate and the overall average rate; greater than 100 suggests that the local mortality rate is higher than the overall average; and, less than 100 suggests that the local mortality rate is lower than the overall average.

The observed deaths are simply the number of deaths which have occurred within a hospital within a particular time period. To derive the expected deaths figure there are items which need to be considered, factors which impact on an individual’s health, data source, and modelling techniques.

**Similarities and differences between RAMI\HSMR**

There are a number of factors which can potentially affect health which need to be taken into consideration when deriving expected deaths. Variables such as age, sex, co-morbidities, socio-economic status, admission method, co-morbidities are factored in to both RAMI and HSMR.

However, the method in which these are factors are accounted for are different. For example, to model the affects of co-morbidities RAMI uses the highest risk secondary diagnosis code whereas HSMR uses the Charlson Index.

There are a couple of noticeable differences in the variables between RAMI and HSMR. For example, CHKS included all in-patient data in their model except for those that fall under mental health, maternity and live births by HRG whereas HSMR includes 56 Clinical Classification System diagnosis groups. CHKS do not include emergency re-admissions, deprivation quintile and palliative care code Z51.5 within the model, but these factors are included in HSMR by Doctor Foster Intelligence, the organisation that compiles HSMR rates.
**Deriving expected deaths**

Two figures are needed to derive either RAMI or HSMR, namely observed number of deaths and expected deaths. Observed deaths within a given setting is a simple count of deceased patients within a specific time frame.

The method used by both systems to derive expected deaths is a logistic regression model. This is used to derive expected deaths in each diagnosis group, adjusting for the above factors which are considered to impact on health and patient outcome.

Each of the factors is assigned a weight related to its effect on whether the patient died or not. An individual patient’s probability of dying can be built up by adding the relevant weight values for each factor in turn. The result for each patient is a figure of between 0 (no chance of dying) and 1 (100% chance of dying). Adding up the figures for all patients gives the overall number of expected deaths.

**The use and validity of mortality measures**

There have been a number of questions regarding the use of case-mix adjusted mortality as an isolated measure of quality and as a tool to compare individual hospitals within league tables. Questions around the validity of the results have fuelled this debate.\(^{16}\) The main focus of these debates looks at factors such as coding, which can improve appearance of RAMI\|HSMR without real quality improvements to patients care.

A complication to consider whilst investigating RAMI is the method used to derive the allocation of risk or the patient’s chances of dying. This is dependent on the completeness, depth and consistency of clinical coding.

The clinical coding of patient records forms part of the estimated likelihood of dying, which is not just based on primary diagnosis but underlying conditions as well. If underlying conditions are omitted this will adversely affect an organisation's RAMI.

Conversely, the more co-morbidities coded will reduce RAMI. In some cases the increased number of codes entered is reflective of local coding practise as opposed to real differences in patient care. The depth and quality of clinical coding is dependent on the completeness of the data source (i.e. patients’ written notes).

Further to this, there is variation in practice of palliative care and end of life coding. The current UK guidelines for use of the ICD-10 Palliative Care code, Z51.5 are based on the Coding Clinic Volume 4, Issue 2, March 2007. The CHKS logistic regression model excludes Z51.5 and includes Z51.8.

It has been suggested that Health Boards are opting to use Z51.5 as this code is excluded from the model as opposed to Z51.8 which is included within the model. The extent to which this affects the RAMI is not fully understood, however, discussions with CHKS suggest using Z51.8 would not significantly impact on individuals RAMI at a Health Board.
It is clear that there is the potential to misuse existing risk-adjusted mortality measures. However, this does not completely invalidate their use. We recommend using RAMI as part of an internal suite of performance measures to improve quality of healthcare is appropriate. As well as using RAMI as a main indicator of quality, we have advised healthcare organisations to investigate their adverse event rate, derived from data obtained by using the Global Trigger Tool (please see separate ‘How to use Trigger Tools Guide’).

In order to improve these system-level outcomes measures, healthcare organisations have been asked to consider a whole suite of process and balancing measures for use as a part of their ongoing improvement in healthcare provision.

**How can we use case-mix adjusted mortality measures?**

**Before use**

- Develop local experts who understand the measures and can answer difficult questions:
  - Data quality - % included in RAMI
  - Fixed baseline to track reliably over time
  - Model effects of changes in coding
  - Check out the probability of death assigned to patient groups

**Don’t use alone**

- Use other measures:
  - Track both actual and expected separately
  - Drill down by condition
  - Build scorecard for safety from driver diagram

**Learn about causes**

- Case note review of deaths
- Front line teams to measure and improve

There are two main ways case-mix adjusted mortality measures can be used:

1. To track change over time against a baseline.
2. To compare performance against a locally agreed target.

In both cases, monthly values are very useful to have. Using both ways can help the organisation to assess how effective its implemented strategies have been in reducing overall mortality rates.
1. Tracking progress over time against a baseline

Step 1: Create your baseline. Deriving a baseline is essential as we need to look at historic performance to help us predict future performance. Using the data which you have obtained from CHKS create your baseline. This is the underlying level of mortality at the start of your campaign or improvement programme. Use at least 2 years of monthly case-mix adjusted mortality data from a period before you started making any changes. Choose full years where possible so that you can see the full effect of any seasonal variation.

Step 2: Plot the monthly values on a run chart.

Step 3: Examine the chart. Does it look like mortality has an upward or downward trend, or is it just random variation that is displayed? You can apply the run chart rules as described in the ‘How to Improve’ guide to help you decide this.

Step 4: Calculate the mean value adjusted for any trend as the prediction for future values. If your historical data contains a strong seasonal pattern, you may want to create more than one predicted value for different times of the year.

Step 5: Continue to plot subsequent mortality values on the chart and apply the run chart rules (see ‘How to Improve’ guide) to test whether you have an improvement.

2. Comparing performance against a locally agreed target

This use of the mortality measure superimposes an external target as well as using historic performance to predict future performance.

Step 1: Understand historic performance. This is the underlying level of mortality at the start of your improvement. Use at least two years of monthly case-mix adjusted mortality data from a period before you started making any changes.

TIP

Choose full years where possible so that you can see the full effect of any seasonal variation.
Step 2: Plot the monthly values on a run chart.

Step 3: Look at the chart. Does it look like mortality has an upward or downward trend or is it just random variation that is displayed? You can apply the run chart rules as described in the ‘How to Improve’ guide to help you decide this.

Step 4: Calculate the mean value adjusted for any trend as the prediction for future values. If your historical data contains a strong seasonal pattern, you may want to create more than one predicted value for different times of the year.

Step 5: Use the historic trend and other evidence about the causes of avoidable mortality in your organisation to help you set an ambitious but achievable target. Remember that the effects of your improvement on this high level quality measure can take some time, at least a year and maybe longer. If your aim is set five years or so ahead, you might want to set some intermediate targets. If your historical data contains a strong seasonal pattern, you may want to take this into account when setting intermediate targets.

Step 6: Continue to plot subsequent mortality values on the chart and apply the run chart rules (see the ‘How to Improve’ guide) to test whether you have an improvement. This is still important to know even if your main focus is achieving your local target. Knowing that you have definite change can help you decide what strategy to adopt next.

Step 7: Monitor progress against your target.

Questions to ask if you do not appear to be on track to achieve your local target:

Is there any sign of improvement at all?
If there isn’t, you need to revisit the interventions.

Have they really been embedded in routine working or are they still at the testing stage?
If there is, you might have been over-ambitious in the timing of your target.

Which interventions are having an effect and which not?
This will show you where you need to revisit your improvement efforts.
How many clinical areas are covered so far?

If you haven’t covered the majority of relevant clinical areas then you probably haven’t got enough spread to effect the mortality measure. Concentrate on spreading the improvements to more areas.

Is the improvement happening fast enough?

The key to getting an impact is to ensure that the improved process is definitely reliable before trying to spread. Reliability can be assumed once six data points consecutively demonstrating compliance of 95% and above have been collected on a run chart. Spreading improvements prematurely results in patchy performance because you haven’t really ironed out all the issues.

**Common causes of high mortality measures**

Table 1 highlights a list of common causes of high mortality measures.\(^{20}\)

| Inappropriate and/or untimely care                                      | • Ineffective systems to identify and rescue the deteriorating patient  
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>• Delays in the process of care e.g. delays to theatre</td>
</tr>
<tr>
<td></td>
<td>• Delays in transferring patients to high dependency unit</td>
</tr>
<tr>
<td>Inappropriate setting of care</td>
<td>Problems accessing critical care</td>
</tr>
<tr>
<td></td>
<td>• Medical outliers on surgical wards</td>
</tr>
<tr>
<td></td>
<td>• Inappropriate admissions from nursing homes, e.g. patients admitted to hospital for end-of-life care</td>
</tr>
<tr>
<td>Poor medicines management</td>
<td>• Antibiotic doses missed</td>
</tr>
<tr>
<td></td>
<td>• Errors in establishing the medication history of patients on admission leading to omission of important drugs</td>
</tr>
<tr>
<td></td>
<td>• Complications from high risk medications e.g. poor control of opiates and Warfarin.</td>
</tr>
<tr>
<td>Hospital acquired infections</td>
<td>• Surgical site infections</td>
</tr>
<tr>
<td></td>
<td>• Central line associated bacteraemia</td>
</tr>
<tr>
<td></td>
<td>• Ventilator associated pneumonia</td>
</tr>
<tr>
<td>Non-clinical issues</td>
<td>Non-clinical issues</td>
</tr>
</tbody>
</table>

**Investigating high mortality measures**
RAMI values can be affected by a number of factors, including data quality, admission thresholds, discharge strategies and underlying levels of morbidity within the population. However, quality of care must also be considered as a contributing factor.

Where a hospital has high RAMI, further investigation is merited, in order to exclude or identify quality of care issues. Hospitals that have taken this approach in the US, UK and other countries have gained a useful insight into mortality at their institution and this has been associated with documented falls in mortality.\(^{20}\)

We recommend using the pyramid model of investigation (Figure 1) when finding credible causes for an apparent high mortality of patients.\(^{21,22}\)

**Figure 1 - Pyramid model for investigating high mortality**

First, examine the data and coding - are all records being coded with the right clinical interventions and are all diagnoses being recorded? Are palliative care patients coded to the Palliative Care specialty or not?

Check the completeness of coding (Health Solutions Wales gives a useful feedback on this) and also how long it takes to complete the coding process. The importance of having local knowledge that understands the current coding processes is a valuable asset to help explain some of variation in RAMI.

Second, examine the difference in case-mix - are there changes in the relative severity of patients being admitted? Look for the proportion included and shifts in co-morbidity scores.

Third, examine changes in structure. Structural factors are recognised as items which can not be easily changed as they dependent on release of substantial resources or policy changes. Examples of these include doctor-patient ratio, availability of equipment.

Figure 2 depicts a causal chain starting from the structures in which management
processes are nested. Institutional process factors include those that are the responsibility of local managers and can generally be affected with modest reallocation of resources (e.g. human resource policies). Institutional factors affect intervening variables, such as how hard or carefully clinicians work and how knowledgeable they are, which in turn affect throughput and clinical processes.\textsuperscript{18}

*Figure 2 - Conceptual map linking various structures and process variables to outcome*

**Fourth**, examine changes in the process of care - for example are palliative care patients now being admitted elsewhere? Check for major changes in the way patients move through the organisation or are directed to community or other service.

**Fifth**, focus on variations in individual or team performance.

Charles Vincent has undertaken extensive work on how to investigate clinical incidents and learn useful lessons from incidents. The following two references may be useful when taking internal investigations within your Health Board:

*Vincent C 2003 Understanding and responding to adverse events. New England Journal of Medicine 348:1051-1056*

*Vincent C. Incident reporting and patient safety. BMJ 2007; 334: 51*
Mortality Measurement - Case studies

Case study 1
Wrightington Wigan and Leigh NHS Foundation Trust (WWLT)

The Problem
In December 2007 WWLT experienced a peak of 137.9 in its HSMR. It was estimated that there are 20 deaths per week within the hospital.

The Trust Board had serious concerns about the raised mortality figure and set reducing mortality as its top priority.

Deaths are dealt with by a Bereavement Officer. At the time a coroner was being notified about relatively few of the deaths and was then taking an overview of the deaths that occurred, with a small proportion of these deaths being followed up with a post mortem.

In order to investigate the high HSMR it was decided to undertake “Death Reviews”.

Investigative methods adopted
The Institute for Healthcare Improvement (IHI) produced a tool for auditing deaths.

The tool required the break down of deaths according to four boxes, split according to the patient being cared for on ITU, or not, and receiving palliative care (for the trust this represented the “Care of the Dying” pathway) or not (see figure 3). Use of this tool allowed the Trust to concentrate on the areas that were considered most likely to contain the deaths that had a preventable component. The main efforts were to look at the non ITU / non Care of the Dying Pathway deaths - i.e. “Box 4”.

Figure 3 - ‘Four box tool for auditing deaths

<table>
<thead>
<tr>
<th>‘Care of Dying’ pathway</th>
<th>ITU</th>
<th>Non-ITU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not on ‘Care of Dying’ pathway</td>
<td></td>
<td>“Box 4” (cause for concern)</td>
</tr>
</tbody>
</table>

(Deaths are allocated to boxes depending on circumstances i.e. whether the patient was in ITU or not, or on the ‘Care of Dying’ pathway or not)
Deaths during the period July 2008 - June 2009 were reviewed. All deaths were notified to the Trust’s Bereavement Office. Notes were held there and reviewed each Friday. The review was performed by the same person each week; a Senior Clinical Coder was also on hand. They looked through each of the notes in the “Box 4” grouping. Data was collected according to the reviewing form (Appendix 1).

Each “Box 4” death was classified as:

**Unexpected**  Deaths where there was no evidence of preparation for the death of the patient. Such deaths would include any where there was an “arrest call” made, or deaths where there were ongoing unresolved care issues (such as assessments for ITU care, or Non-invasive Ventilation)

**Expected**  Deaths where there was clear evidence of preparation for death. This normally includes a DNAR (Do Not Attempt Resuscitation) form, evidence of discussion with family members, and comments from the team caring for the patient about limitations of provision of care (such as not suitable for ITU, and Non-invasive Ventilation)

**Data Analysis**

The Hospital performed 39 separate weeks’ reviews of deaths during the period July 2008 to June 2009. During the weeks of the reviews there were 963 deaths, 904 of which were included in the review. The patients that were not included in the review were omitted because notes were not available (which included patients who died on the afternoon of the review, notes for patients having post mortem on the afternoon of the review, or notes sent to the Coroner’s Office).

Table 2 provides a summary of the deaths within the review.

<table>
<thead>
<tr>
<th>Category of deaths</th>
<th>Number of deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensive Care Unit</td>
<td>75</td>
</tr>
<tr>
<td>Care of dying pathway</td>
<td>376</td>
</tr>
<tr>
<td>Brought in to die</td>
<td>66</td>
</tr>
<tr>
<td>Expected</td>
<td>271</td>
</tr>
<tr>
<td>Unexpected</td>
<td>125</td>
</tr>
</tbody>
</table>
Some of the issues raised by the Death Reviews include:

- Medical Early Warning Score
- ITU Outreach
- Feeding of elderly patients
- Neck of Femur fracture; delay in time to theatre / care pathways
- Patients “brought in to die” in the week of New Year after falls
- Non Invasive Ventilation
- Thromboprophylaxis
- Hypothermia
- Use of Care of the dying pathway
- Enemas in bowel obstruction
- Death certification
- Coding
- Falls
- Management of raised INR
- Morphine overdose
- Brought in to die from Nursing Homes

Action

The weekly nature of the death reviews led to an iterative process where they identified issues, and then sought to encourage teams to resolve the problems. The Trust continued to monitor progress in future reviews. There were a large number of issues raised during the year, the most significant were identified by the death review (listed above).

Each of the issues arising from the deaths review led to further discussion and work. The Trust had noted concern in respect of the early identification of deterioration focussed on the development of its ITU outreach team, and, embedding both use and action on Modified Early Warning Score (MEWS).

Certain issues had already been identified as possible areas for improvement such as falls and non-invasive ventilation, but the link with patients dying became a driver for change in other areas there were not previously identified the potential for problems.

Hypothermia in hospital was entirely unexpected. The Trust found that frail elderly patients in hospital could become hypothermic. They were often given extra blankets, which further insulated them from the warm environment. These patients need active warming, and this now occurs.

The Trust noted that patients were not fed for protracted periods because of concern about swallowing. This required a cultural change in the way that patients were managed, to ensure they were fed.
Medicines management was a significant feature. Patients with raised INR were admitted and anticoagulation stopped, but not actively reversed. This included patients waiting for definitive treatments such as surgery for neck of femur. Morphine was the most commonly noted drug problem, though failure to comply with thromboprophylaxis was the most significant. Once again, the clear link with mortality remained a driver for improvement.

The Trust found that a number of patients were admitted from Nursing Homes in very poor condition, without realistic hope of improvement. This was considered inappropriate, and denied them a peaceful death within familiar surroundings. They have worked with their partner PCT to enable more patients who are severely ill to die peacefully in non-hospital settings (e.g. nursing homes).

Implementing the changes and engagement

*Communicating the results to staff, and senior management*

The circulation of the reviews to an important proportion of the medical and nursing staff helped staff engage with the Improving Mortality programme. Reviews were circulated by email, and generated various email conversations about the issues raised. These were also reflected in audit and directorate meetings. Particular issues raised by the reviews were responsible for setting up separate work streams to deal with the problems.

*The result*

By February 2008 the HSMR had decreased and the Trust considered that the death reviews have helped to produce the significant fall in HSMR evident in Figure 4.

*Figure 4 - Relative risk for all diagnoses*
When the Trust commenced the death reviews it was anticipated that reducing the number of unexpected deaths was the most important component of reducing mortality. However, the numbers of such deaths was relatively small, and whilst there may have been a small reduction in the numbers of unexpected deaths by the early recognition of deteriorating condition, this was a minor contribution to the reduction in mortality.

The reduction in the numbers of expected deaths is numerically more significant, as there are many more such deaths. Given that the teams caring for these patients clearly anticipate their dying prior to the patient’s death, any reduction must come from systematic improvements in care that reduce overall risk.

They identified a number of such improvements, including reducing hypothermia in hospital, and improving nutrition by resolving feeding issues, thromboprophylaxis, improving time to theatre for Neck of Femur operations, C. Difficile infection and falls. Improvement in these will reduce expected deaths rather than unexpected ones, and are rarely identified as causes of death in their own right.

**Conclusion**

Reviewing deaths can be an important part of reducing mortality as measured by HSMR and total deaths. The fall in mortality appears to be predominantly due to a reduction in the numbers of expected deaths, and improvements in systems of care. Identification of the need to reduce mortality as the top priority for an acute Trust is the first point on this journey, and reviewing deaths is an important route of travel.
Case Study 2
Bradford Teaching Hospitals Trust

“A key function of hospitals is to save lives, so it’s surprising how little attention is paid to hospital mortality. Our work in Bradford shows that a hospital mortality reduction programme can make a big impact by significantly reducing mortality rates.

Health professionals are passionate about our efforts to save lives. Senior managers want reassurance about clinical governance standards. Patients want to know their hospital is safe. It’s a natural top priority.”

John Wright, Clinical Director, Bradford

Bradford Teaching Hospitals NHS Trust joined an international programme, Pursuing Perfection, after becoming aware of wide variation in hospital mortality level, which could not be fully explained by case-mix variable.

Pursuing Perfection was organised by the Institute for Healthcare Improvement and aimed at improving quality of care and commenced in 2002.

Three years after the programme started, the work undertaken meant Bradford’s HSMR fell significantly from 94.6 (95% confidence interval 89.4, 99.9) in 2001 to 77.5 (95% CI 73.1, 82.1) in 2005. This translates as 905 fewer hospital deaths than expected during the period 2002-2005.

There were a number of key stages which were followed by the Bradford Teaching Hospitals Trust which resulted in their reduction of the HSMR Value. The following are summaries of the key stages:

Investigative methods undertaken

The programme started with a review of hospital deaths to inform work priorities. A detailed case-note audit of consecutive hospital deaths was undertaken to identify gaps in the quality of care. A team consisting of an intensivist, lead clinician, pharmacist and nurse were established for four specialties associated with the majority of hospital deaths: care of the elderly, medicine, surgery and trauma, and, orthopaedics.

Each team was asked to audit a sample of case notes of 30 consecutive patient deaths using a detailed structured audit form: 118 patient records were reviewed. Analysis revealed a high prevalence of sub-optimal clinical observations, hospital acquired infections, and medication errors. In addition, an audit of 411 consecutive hospital deaths was carried out by the palliative care team to identify patients admitted to hospital ‘to die’. The key findings of both reviews are combined in Table 3.
Table 3 Summary of Case Note Reviews

<table>
<thead>
<tr>
<th>Work area</th>
<th>Percentage</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-optimal clinical observations</td>
<td>61</td>
<td>72</td>
</tr>
<tr>
<td>Hospital acquired infection</td>
<td>23</td>
<td>27</td>
</tr>
<tr>
<td>Medical errors</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Deaths within 24 hours in hospital</td>
<td>24</td>
<td>99</td>
</tr>
<tr>
<td>Deaths after two weeks in hospital</td>
<td>27</td>
<td>111</td>
</tr>
</tbody>
</table>

The results of the reviews were used to direct the change strategies and identify the priority areas. Objectives were based on gaps in care identified around clinical observations, medication errors, end-of-life care and infection control.

**Strategies for change**

A mortality reduction group was established by the Chief Executive to co-ordinate a strategic approach to the work. There were a number of objectives based on the gaps in care which had been identified by the reviews which included:

**Surveillance**

A surveillance system was put in place to increase awareness and reviews of deaths, which included:

- Provision of monthly mortality data by departments
- Feedback summaries of routine data collection from hospital data and death certificates for each hospital death
- Regular review of statistical control chart for departmental mortality by the Trust Board and management committees

**Clinical Observations**

The high prevalence of sub-optimal clinical observations prompted the trust into looking to improve reliability in this area. This focussed on:

- Modified early warning score introduced through a training for nursing staff
- Scoring tool prompts, indicating the severity of patients condition and when clinical intervention is required
- Integrated standardised clinical observation record which included training junior medical staff
- Series of training session on acute emergency recognition and treatment (ALERT) provided for all clinical staff
**Place of death**

The results of the audit demonstrated that some patients were being admitted to hospital to die, and a number of patients were being kept in hospital for long periods prior to death. To improve the end-of-life care the palliative care team undertook a number of actions including:

- Providing staff in each department with how to diagnose a dying patient and plan appropriately according to patient’s wishes.
- Creating awareness of community services.
- An education programme for nursing homes to encourage nursing homes to care for dying patients as an alternative to hospital admission.

**Infection control**

The hospital policy was revised and strengthened to reduce potential hospital acquired infections. Key changes included:

- Hand hygiene campaigns and introduction of near patient-alcohol rub
- Staff awareness sessions
- Improvement of ward cleaning routines
- Compulsory induction training for all staff
- Antibiotic guidelines for the hospital
- Increased surveillance and feedback of infection rates

**Medication Errors**

The audit had not demonstrated a link between medication errors and any patient deaths. However, a programme of work was established to improve patient safety. The following areas were targeted:

- Review of high risk medicines including warfarin, heparin, potassium and methotrexate. Results demonstrated issues with out of international range normalised ratios (INRs) which led to a review of anticoagulant prescribing guidelines and standardising of prescription charts.
- Reducing medication errors during admission and discharge. Gaps in communication between primary and secondary care were identified. Discharge letters were revised to highlight changes in medications and an electronic system for accessing primary care records of patients admitted to hospital was introduced.

All these interventions were implemented in the first six months of 2004. Regular meetings of senior clinicians and managers occurred to regularly review and encourage progress.
The result

Chart 1, demonstrates Bradford Teaching Hospitals Trust’s HSMR for 1996–2005 had been average or below average prior to 2002. From 2001 onwards the HSMR continues to fall which could be a result of an ongoing improvement work or continuation of trend in the data. However, since the start of the improvement programme the HSMR has reached its lowest point in 2005.
Case Study 3
**Walsall Hospitals NHS Trust**

*The problem*

When HSMR measures were first published in England in 2000, the Walsall Hospitals NHS Trust had the highest ratio in the country - 1,080 deaths, compared with the 830 that would be expected based on the mix of patients that it cared. This translated into an HSMR of 130.

In 2001, after a wide range of improvements were introduced, the HSMR value began to fall. Walsall’s Medical Director, Mike Browne, discussed his first reaction and implications for his Trust.

“When the Dr Foster data was first published it was rather like having a major incident. We spent a lot of time setting up what I think is a first class clinical governance framework. We focused on mortality and looked at all the outlying areas.

“We set up seven groups - each group was given outliers to look at and identify where things could be done as well as a senior director to give it clout. There was no simple way to change things - no single cause. It was one long slog across the board.”

Mike Browne and his colleagues formed clinical governance groups to implement changes in clinical disease areas:

- heart
- malignant
- gastrointestinal
- respiratory
- renal
- diabetes
- other vascular groups
- trauma and orthopaedics
- anaesthetics
- resuscitation
- accident and emergency
- critical care
- outpatients
- dietetics
- children
- elderly care
Similarly, changes were initiated at all levels in management areas:

- audit department
- clinical risk
- continuing professional development unit
- bed management
- information services and performance management
- research and development
- education
- discharge liaison team
- workforce development
- integrated care pathway development
- confidential inquiries
- NICE guidelines
- NSF update reports
- clinical governance structure
- Primary Care Trust Evercare project

**Outcome**

In a four year period, the Trust reduced its HSMR to 93 through this broad-based clinical governance strategy. The Hospital’s approach included exploring options for improving end-of-life care as well as a series of clinical quality improvement initiatives. Chart 2 demonstrates Walsall’s Hospitals NHS Trust HSMR for the period 1996/97 - 2005/06. For the period between 2000/01 - 2005/06 there has been a reduction in the HSMR value as a result the new clinical governance framework which was put in place.

*Chart 2*

Sustaining the progress is a challenge, as recently, Walsall’s HSMR has begun to trend back up. The hospital has set reducing hospital mortality as a top priority for improving patient safety for 2006-2007.
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