NHS
National
Services
Scotland

Hospital Standardised Mortality Ratio

Quarterly Release

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Contents

Introduction

This report by the Information Services Division provides quarterly Hospital Standardised Mortality Ratios (HSMR) at Scotland, NHS Board and hospital levels. It includes additional information and commentary on patterns of mortality by key demographic factors. There is extensive information on the development of the measure and how it compares to similar information used in other parts of the UK.

Information Services Division has produced quarterly Hospital Standardised Mortality Ratios for all Scottish hospitals participating in the Scottish Patient Safety Programme since December 2009. The original aim of the Scottish Patient Safety Programme was to reduce hospital mortality by 15% by December 2012 subsequently extended to a 20% reduction by December 2015. Following this the opportunity was taken to re-base the model, ensuring that the predicted mortality used within the HSMR calculation is based on up to date data.

The new aim of the Scottish Patient Safety Programme is to reduce hospital mortality by a further 10% by December 2018.

HSMRs published from August 2016 onwards cannot be compared to previous releases using a different baseline period.

These latest statistics reflect completeness of validated hospital SMR01 returns as at 14th July 2017. This information has previously been released to NHS Boards as management information.

Hospital Standardised Mortality Ratios

Hospital Standardised Mortality Ratios (HSMRs) adjust death data (referred to in this report as mortality data) to take account of some of the factors known to affect the underlying risk of death.

The calculation uses information from acute inpatient and day case patients admitted to all medical and surgical specialties in NHSScotland (apart from obstetrics and psychiatry which are excluded). The calculation takes account of patients who died within 30 days from hospital admission. This means that the HSMR also includes deaths that occur outside hospital.

These statistics are updated on a quarterly basis and reflect the HSMR for each quarter independently. All data is presented quarterly to show trends. A link to the relevant Excel data table has also been provided alongside each chart.

How is HSMR calculated?

For a standard population (Scotland) during a baseline period (January 2011 to December 2013), the risk of dying for particular patient subgroups (eg age, sex, diagnosis, type of admission, number and severity of illness etc.) is calculated.

This risk is then applied to the corresponding subgroups in different hospitals to calculate how many deaths would be predicted to occur in that hospital if the standard level of risk was applied.

This predicted figure is then compared with the actual observed number of deaths that did occur within the hospital to give the standardised ratio.

HSMR = Observed Deaths / Predicted Deaths

Main points

- HSMR at Scotland level has decreased by 8.4% since January to March 2014 (first quarter after new baseline) and January to March 2017.

- For the period January to March 2017, one hospital had significantly higher standardised mortality ratios than the national average: Royal Alexandra/Vale of Leven (HSMR of 1.13).

- One hospital had significantly lower standardised mortality ratios in January to March 2017 than the national average: Western General Hospital (HSMR of 0.77).

- Unadjusted hospital mortality has been falling consistently since prior to the baseline period used to calculate the HSMR.

- Emergency or unplanned medical admissions consistently account for the largest proportion of deaths within 30-days of admission.

- Patients from the least deprived areas of Scotland consistently have lower levels of crude 30-day mortality than patients from more deprived areas.

Comparing HSMR with previous years

During 2015/16, ISD undertook a review of the methodology used to calculate HSMR. A Review Paper was subsequently produced with recommendations for refining the model methodology following the end of the Scottish Patient Safety Programme aim. The methodology used by ISD was updated in August 2016 and HSMR releases prior to this point are not comparable.

A Technical Document is available on how the HSMR is now calculated and describes the methodology used in more detail. Interpretation Guidance and Frequently Asked Questions documents are also available, answering questions on the differences between the methodologies.

Interpreting HSMR results

Individual quarterly HSMR

The HSMR value for NHSScotland for the new baseline period (January 2011 to December 2013) has been re-set to one. This allows quarterly hospital values to be compared to the baseline period for Scotland.

- If an HSMR value is less than one: This means the number of deaths within 30 days of admission for a hospital is fewer than predicted.
- If an HSMR value is greater than one: This means the number of deaths within 30 days for a hospital is more than predicted.

If the number of deaths is more than predicted this does not necessarily mean that these were avoidable deaths (ie that they should not have happened), or that they were unexpected, or attributable to failings in the quality of care.

HSMR trends

Trends in HSMR are impacted by variations in case mix and coding practices over the period.

The calculation of predicted deaths each quarter is based on risk associated with particular patient sub-groups during the period January 2011 to December 2013 data.

Any improvements in the quality of care and treatment; changes in the severity of illnesses in patients admitted to hospital; changes in the provision of palliative and end-of-life care; and changes to the completeness and accuracy of hospital discharge summaries/clinical coding will not be reflected in the calculation of future predicted deaths.

For this reason HSMR trends should be considered alongside crude mortality rates

How HSMR information is used

Safety is a priority ambition for the Healthcare Quality Strategy for NHSScotland and a national reduction in HSMR should reflect work in individual hospitals to review mortality, and reflect reduction in serious adverse events and infections under the Scottish Patient Safety Programme and other improvement initiatives.

Health Improvement Scotland reviews the data with the Information Services Division to identify potential patterns in the data and start dialogue with NHS Boards where appropriate. Healthcare Improvement Scotland may also initiate a dialogue with an NHS Board if a hospital is identified as having:

- a high quarterly HSMR value compared with the national average or its own historical average values;

- an increasing trend over time, or;

- a series of HSMR values which are consistently above the Scottish average.

Should there be any evidence on either basis that an unusual pattern of mortality exists or may be emerging for a particular hospital, then a formal dialogue is initiated with the NHS Board concerned in a written communication from the Clinical Director of Healthcare Improvement Scotland.

The Scottish Government use these statistics to: monitor change in hospital mortality over time; inform policy decision making; respond to parliamentary and public business. One example of this was in the commissioning of the NHS Lanarkshire Rapid Review Assessment.

NHS Boards use these statistics to reflect on the quality of patient care, monitor local hospital mortality and report on their progress. A considerable amount of activity is being carried out in individual hospitals nationwide to use this tool to reflect on clinical practice and facilitate improvements in patient care e.g. through Preventing Harm Action Plans.

In addition, a guide for NHS Boards –has been developed 'Using the Hospital Standardised Mortality Ratio to help improve patient care'.

To help local users better understand their data, and to encourage a sense of ownership of the information an infrastructure has been put in place, in partnership between ISD and Healthcare Improvement Scotland, offering:

- sub-group analysis;

- individual audit of case-listing;

- our assistance in interpretation of the national statistics and local intelligence.

Results and Commentary

1 Trends at Scotland Level

Scotland (Overall)

Chart 1 shows the HSMR at Scotland-level between January to March 2011 and January to March 2017. Although the HSMR has remained relatively flat over this time period, it does show clear seasonal patterns with slightly higher HSMRs around the winter quarters (i.e. October to March).

The Scottish HSMR has decreased by 8.4% between January to March 2014 and January to March 2017, estimated from regression line values. The same technique is used to measure the change in HSMR for each participating hospital (Table 2).

Possible factors contributing to changes in the HSMR include:

- reduction in underlying population-based mortality
- improvements in the quality of care and treatment;
- increases in available medical treatments and risk factor improvements;
- reductions in injury or harm to people from healthcare they receive;
- changes in the severity of illnesses in patients admitted to hospital that are not fully corrected for (standardised) by the statistical model used to produce HSMR;
- changes in the provision of palliative and end-of-life care (currently not explicitly factored into the case-mix adjustment due to existing practices for capturing the information), and:
- changes to the completeness and accuracy of hospital discharge summaries/clinical coding (See Data Quality and Timeliness section for further information).

Linear regression is a statistical technique used to fit a straight line through a sequential set of data points. A regression line has been fitted to the HSMR trend from the baseline period (January 2011 to December 2013) through to the latest HSMR. This technique is used to smooth out seasonal variations in HSMR and to provide a more stable basis on which to monitor long term change. The percentage change is calculated as the difference between the regression line values of January to March 2014 (first after baseline) and January to March 2017.

Chart 1: HSMR for deaths within 30-days of admission; Scotland, Jan-Mar 2011 to Jan-Mar 2017p

The data relating to this chart can be found in Table A1b
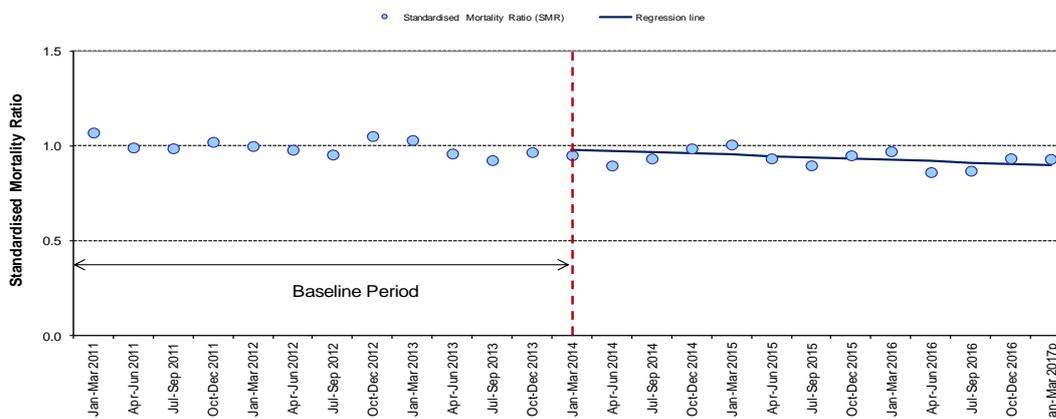
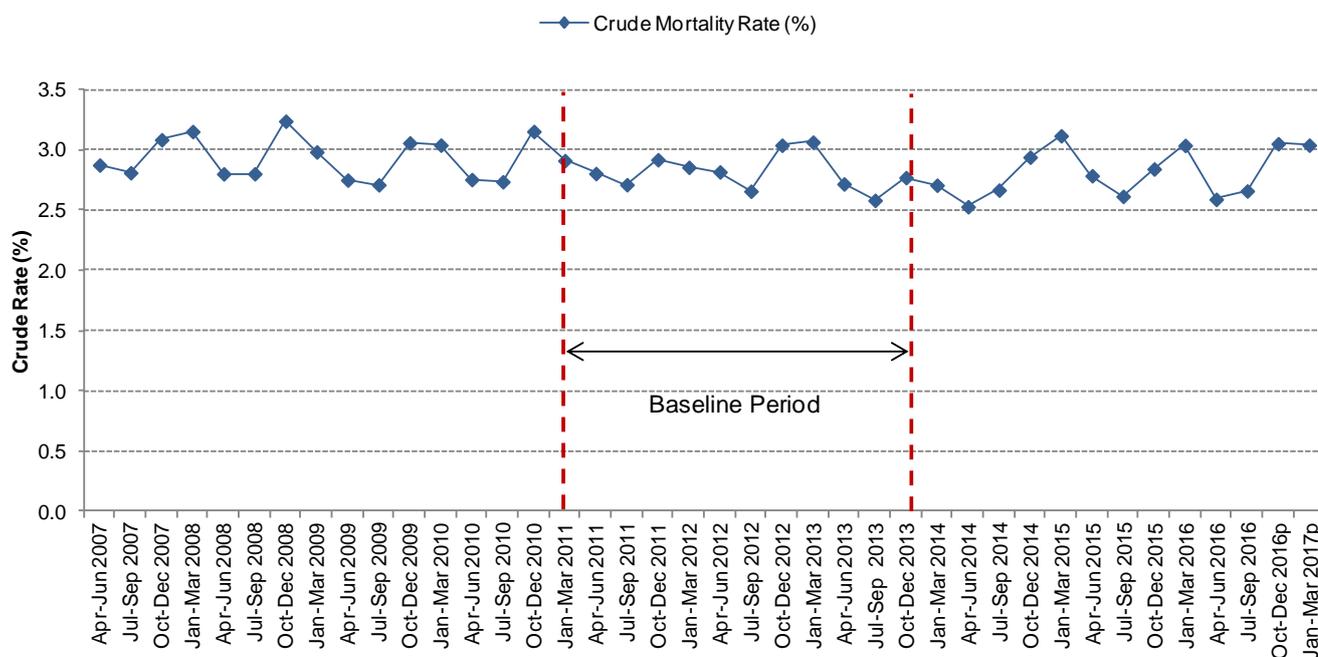p - Provisional (see Appendix A3 - Data Quality and Timeliness)

The balance of contributions to the reducing HSMR from improved quality of care and changes in case-mix are not fully standardised by the model, and improvements or changes in completeness or accuracy of coding, remains unclear. It is expected that there will be a better understanding of this in future as further work is carried out to refine and further utilise this measure.

Scotland Long Term Crude Mortality Trends – from 2007

Chart 2 shows that overall crude hospital mortality (%) at Scotland level from April – Jun 2007 to January - March 2017, according to the existing definition of deaths within 30-days of admission, has fallen from a level consistently around 3% prior to the baseline period. The seasonal pattern previously highlighted is again exhibited in this chart.

Chart 2: Overall crude mortality rates (%) for deaths within 30-days of admission; Scotland, Apr-Jun 2007 to Jan-Mar 2017p

The data relating to this chart can be found in Table A2a

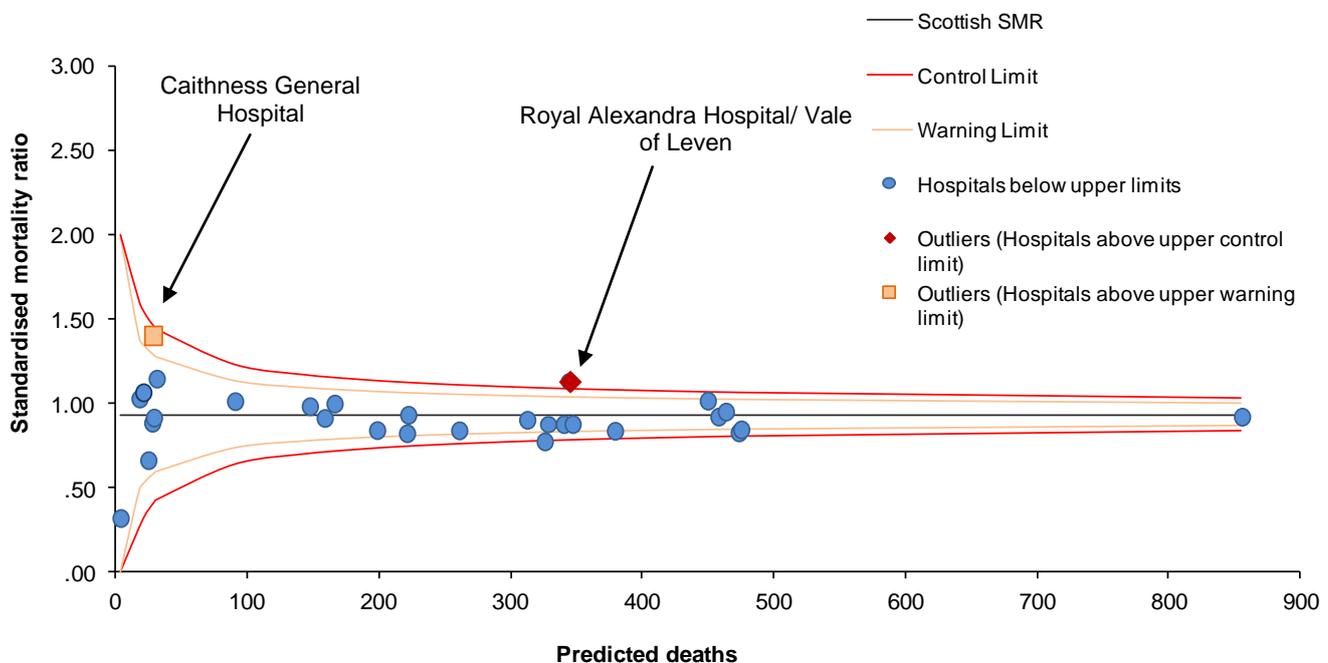p - Provisional (see Appendix A3 - Data Quality and Timeliness)

2 Time in Point Comparisons

A funnel plot is a type of 'Statistical Process Control' chart that helps to show data at a particular point in time. Funnel plots in this report allow comparisons to be made between each hospital and the average for Scotland for a particular period. Please refer to the Funnel Plots appendix for further information on interpretation.

Chart 3 shows the funnel plot for the latest quarter. Individual hospitals can be identified using the key under the graph, which lists the hospitals in the order in which they are plotted along the horizontal axis. This shows that there is one hospital above the upper control limit which is three standard deviations above the Scottish average: Royal Alexandra/Vale of Leven Hospital with an HSMR of 1.13. Additionally, Caithness General Hospital is above the upper warning limit at two standard deviations from the Scottish average with an HSMR of 1.40.

Chart 3: HSMR for deaths within 30-days of admission (Funnel Plot); Jan-Mar 2017p

The data relating to this chart can be found in Table A1c

p - Provisional (see Appendix A3 - Data Quality and Timeliness)

3 Scotland (Sub-Groups)

Scotland – by type of admission

HSMR is by definition an overall indicator that encapsulates mortality outcomes against overall hospital activity. It is possible to examine trends in the same 30-day mortality outcome for some of the underlying factors.

Chart 4 shows the mortality trend according to the four broad categories of patients treated in hospital. The categories describe a composite measure that combines whether the patient was an elective or non-elective admission with whether the patient was admitted to a medical or surgical specialty.

It shows that non-elective medical patients consistently account for the largest proportion of deaths within 30-days of admission and that elective surgical admissions account for the smallest.

Chart 4: Crude mortality rates (%) for deaths within 30-days of admission by type of admission; Scotland Apr-Jun 2007 to Jan-Mar 2017p

The data relating to this chart can be found in Table A2a
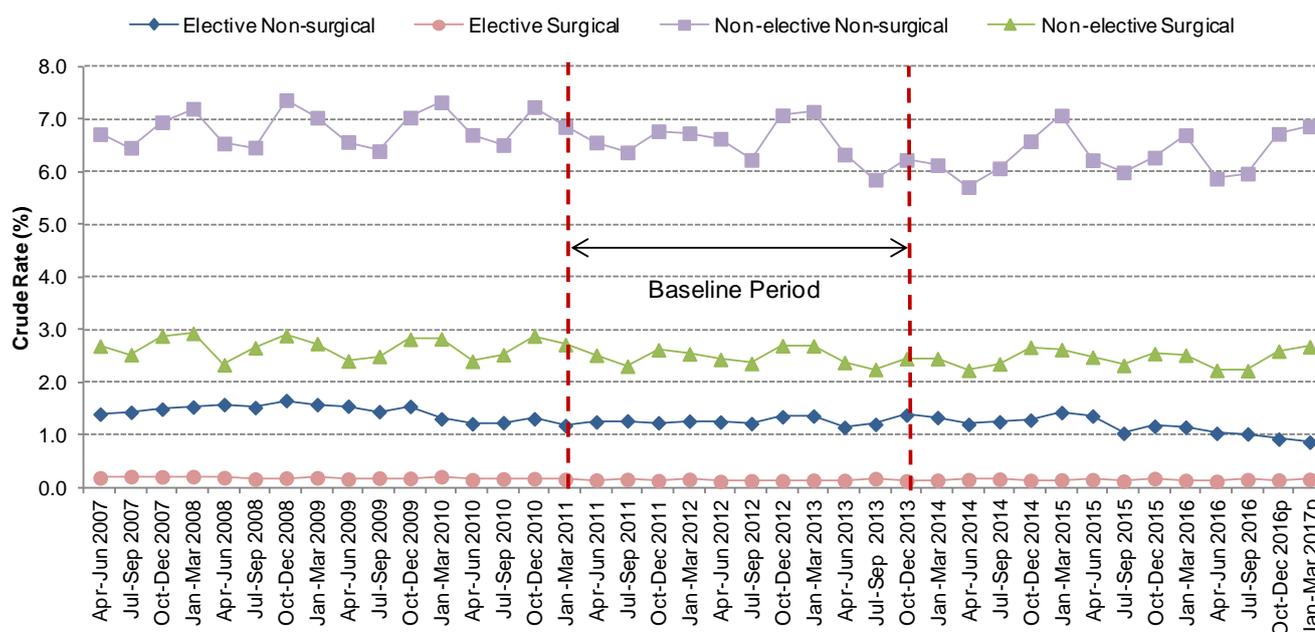
p - Provisional (see Appendix A3 - Data Quality and Timeliness)

Scotland – by age-group

Chart 5 shows that mortality within 30-days of admission increases with age.

Chart 5: Crude mortality rates (%) for deaths within 30-days of admission by age group; Scotland, Apr-Jun 2007 to Jan-Mar 2017p

The data relating to this chart can be found in Table A2a

p - Provisional (see Appendix A3 - Data Quality and Timeliness)

Scotland – by gender

Chart 6 shows that mortality rates are consistently higher for males throughout the time period. The difference between the mortality for males and females has also remained relatively constant.

Chart 6: Crude mortality rates (%) for deaths within 30-days of admission by gender; Scotland, Apr-Jun 2007 to Jan-Mar 2017p

The data relating to this chart can be found in Table A2a
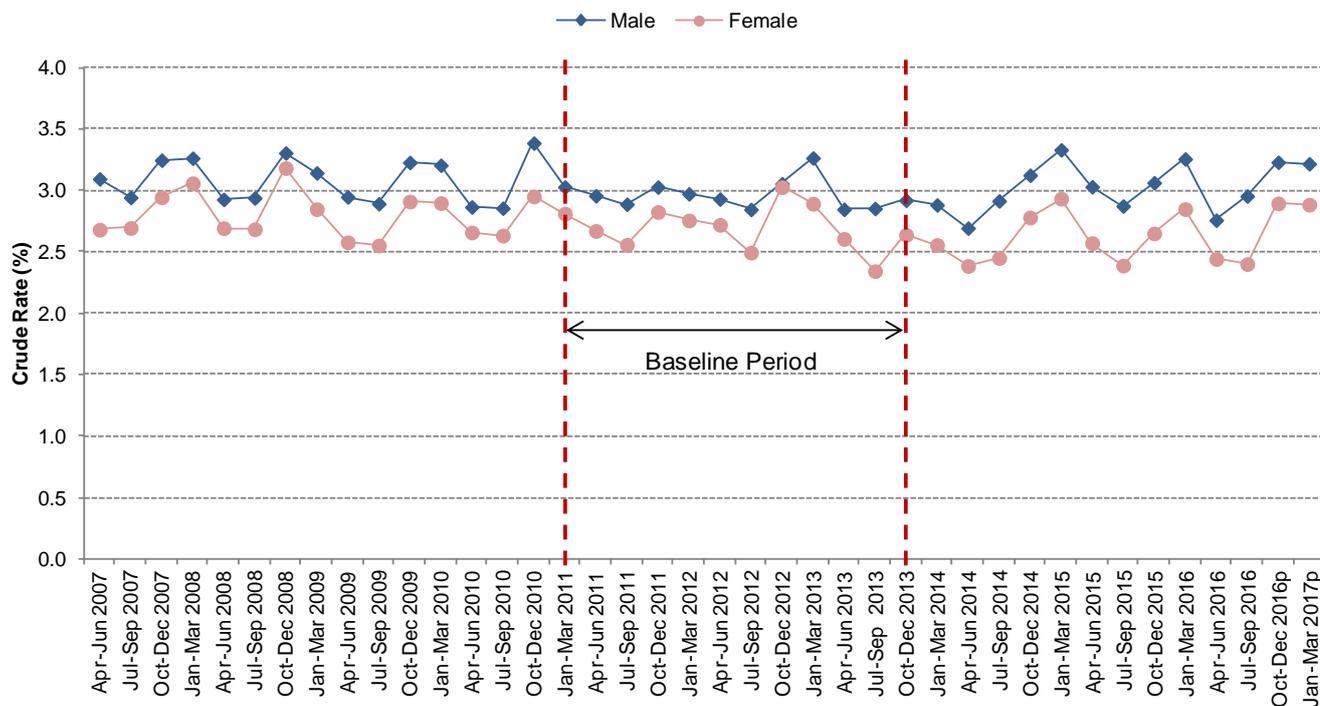
p - Provisional (see Appendix A3 - Data Quality and Timeliness)

Scotland – by Scottish Index of Multiple Deprivation

The Scottish Index of Multiple Deprivation presents a picture of multiple deprivation across Scotland. It identifies small area concentrations of multiple deprivation across all of Scotland in a fair way based on six domains - employment, income, health, education, access and crime.

Chart 7 shows that patients from the least deprived areas of Scotland consistently have lower levels of 30-day mortality than patients from more deprived areas.

Chart 7: Crude mortality rates (%) for deaths within 30-days of admission by deprivation; Scotland, Apr-Jun 2007 to Jan-Mar 2017p

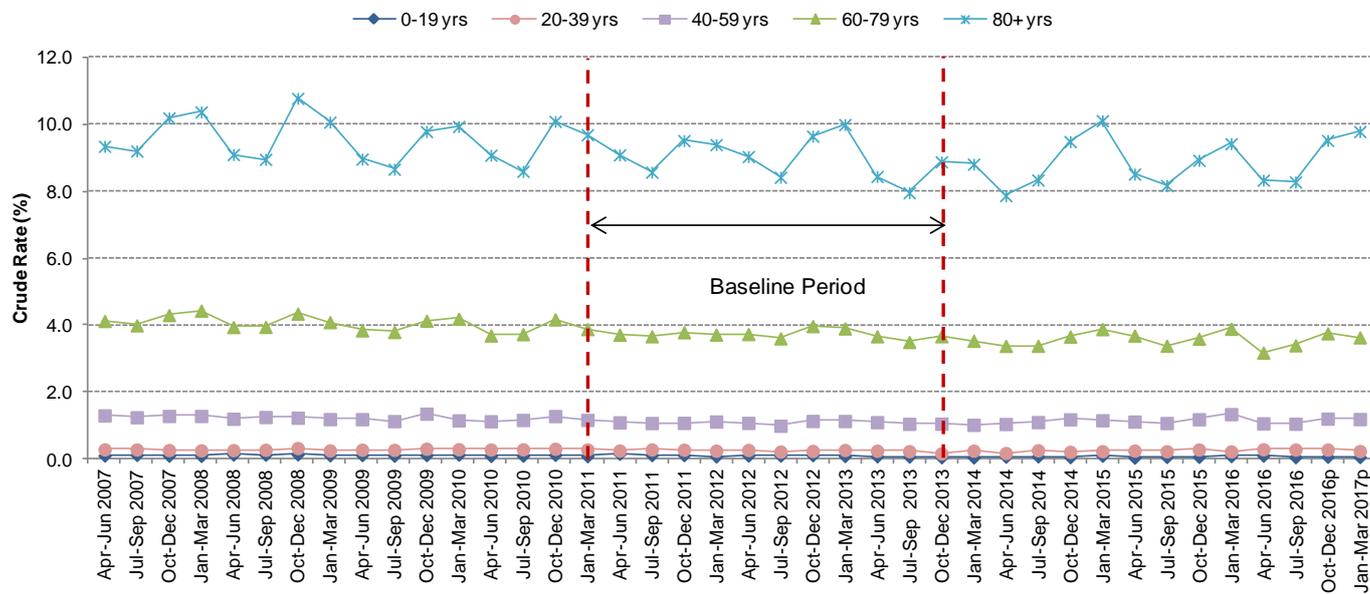The data relating to this chart can be found in Table A2a

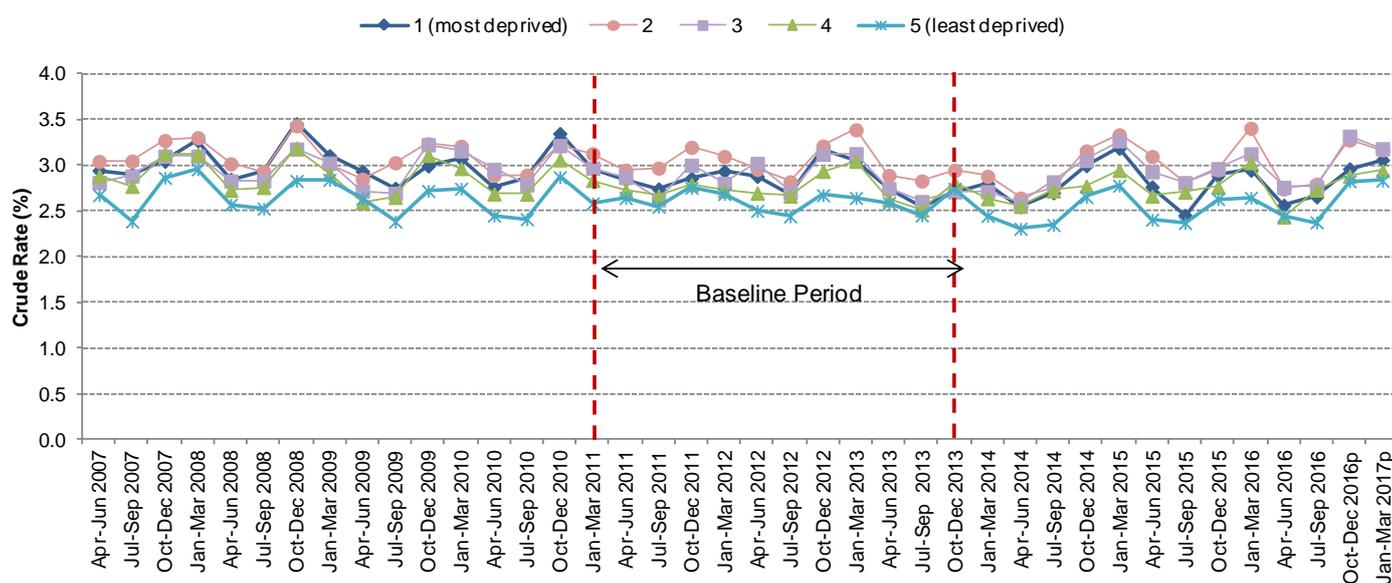p - Provisional (see Appendix A3 - Data Quality and Timeliness)

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4 Hospital and NHS Board Trends

HSMR data are provided by ISD to allow an individual hospital to monitor its progress over time. The process was not primarily designed to compare hospitals and, therefore, we present information in a way that focuses on individual hospitals progress over time.

There are a number of factors which will influence HSMR values and the percentage change over time, these can include the following.

- Random variation in the number of observed deaths particularly in smaller hospitals.
- Data quality variations in the completeness and accuracy of the recording of data from patient records, particularly misattribution and coding of main diagnosis.
- Palliative care and terminal care support services in the community for the local populations served.
- Specialist services and changes to service configuration.
- Hospitals with lower initial HSMR values may find less opportunity to reduce their HSMR at a rate achieved by an otherwise similar hospital but with a higher initial level of HSMR.

As there are fluctuations within and between quarterly observations, a single apparently high value of the HSMR is not sufficient evidence on which to conclude that a poor quality or unsafe service is being provided. It should be regarded as a trigger for further investigations.

Combined Institutions

In order to reflect current service configuration, some hospitals are presented as combined institutions for the purposes of these reports. This applies to the following NHS Boards.

- **NHS Fife:** In order to reflect current service configuration, the HSMRs for Queen Margaret Hospital and Victoria Hospital have been combined. This change has been applied to all time points retrospectively back to the initial reporting period. Gynaecology activity from the former Forth Park Hospital has also been retrospectively incorporated within this new NHS Fife combined HSMR; obstetric activity is not included in the definition of the Scottish HSMR.

- **NHS Forth Valley:** In order to reflect current service configuration, the HSMRs for the former Falkirk & District Royal Infirmary, Stirling Royal Infirmary and the new Forth Valley Royal Hospital are combined. This change has been applied to all time points retrospectively back to the initial reporting period.

- **NHS Greater Glasgow and Clyde:** In order to reflect current service configuration, the HSMRs for Stobhill Hospital and Glasgow Royal Infirmary have been combined as have the activity for Royal Alexandra Hospital and Vale of Leven. Additionally the Queen Elizabeth University Hospital opened to patients in April 2015, since then services from the Southern General, Victoria Infirmary and Western Infirmary/ Gartnavel have transferred to this new hospital. These changes have been applied to all time points retrospectively back to the initial reporting period. In addition NHS Greater Glasgow & Clyde combine any activity (historic or current) from Blawarthill Hospital, Drumchapel Hospital, Glasgow Homoeopathic Hospital, Knightswood Hospital, and Beatson Oncology Centre with Queen Elizabeth University Hospital data.

Individual hospital level data for these combined sites are available on request.

Percentage Change

19 out of 29 hospitals participating in the Scottish Patient Safety Programme have shown a reduction in HSMR since January to March 2014 (first quarter after new baseline). 11 of these have shown a reduction in excess of 10%:

- University Hospital Ayr
- University Hospital Crosshouse
- Dumfries & Galloway Royal Infirmary
- Forth Valley Royal Hospital
- Inverclyde Royal Hospital
- Hairmyres Hospital
- Monklands District General Hospital
- Ninewells Hospital
- Wishaw General Hospital
- Balfour Hospital
- Western Isles Hospital

5 In-patient mortality and deaths within 30-days of discharge

Chart 8 shows the trend in mortality at Scotland level according to a definition similar to the Summary Hospital-level Mortality Indicator in England. SHMI takes account of in-patient mortality and deaths within 30-days of discharge. The Scottish HSMR does not include patients that die in-hospital more than 30-days from admission. In Scotland the decision was to associate the outcome with decisions made at the point of admission (see Inter-UK Comparisons: England and Wales section for more information on the differences between the Scottish and English approaches).

For the latest quarter (January – March 2017) there were 6,952 deaths within 30-days of admission to hospital in Scotland, and 8,411 deaths within 30-days of ultimate hospital discharge (including all in-hospital deaths). The mortality rates are inevitably higher than the admission-based method, reflecting the longer opportunity for follow-up. The trend is however consistent with the admission based mortality patterns, and show that although exhibiting seasonal variation, hospital mortality has fallen over the past ten years.

Chart 8: Crude mortality rates (%) for deaths within 30-days of ultimate hospital discharge (includes all in-hospital mortality); Scotland, Apr-Jun 2007 to Jan-Mar 2017p

The data relating to this chart can be found in Table A2b
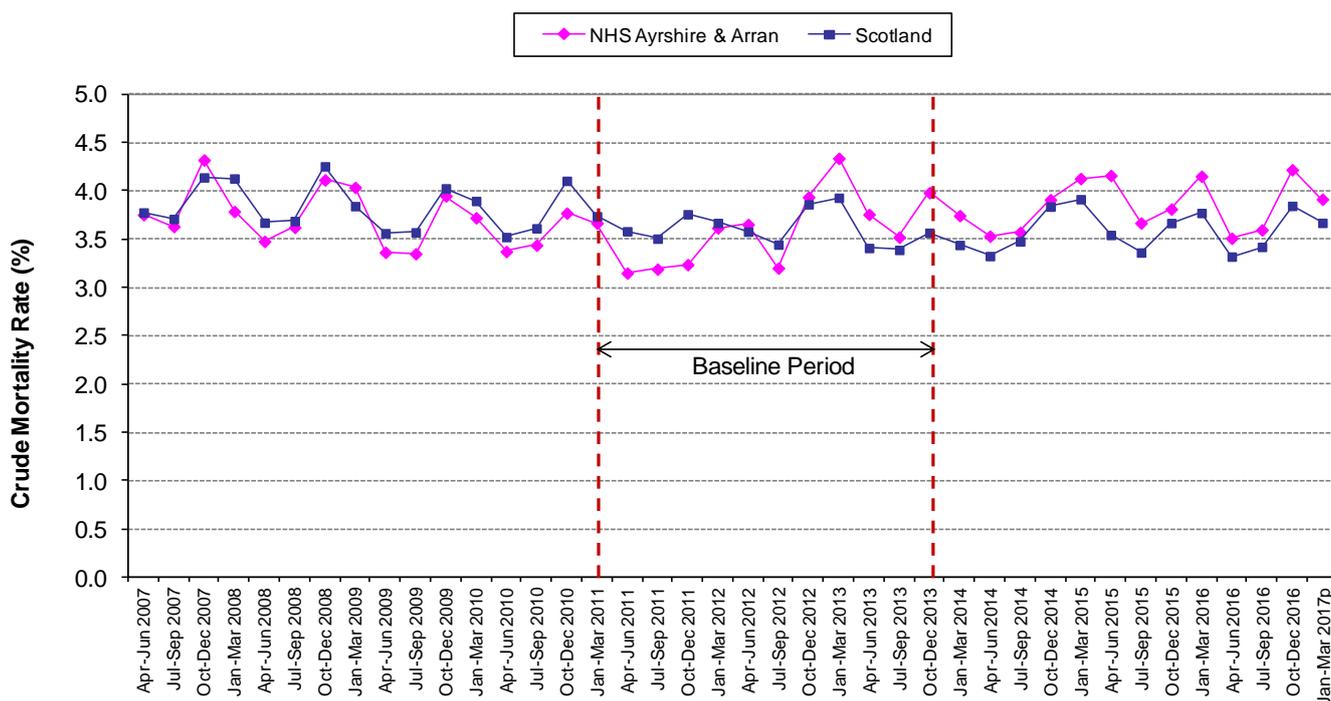
p - Provisional (see Appendix A3 - Data Quality and Timeliness)

Table A2b provides a chart similar to Chart 8 containing the trend for each NHS Board of treatment plotted against Scotland.

6 Population-based Mortality

HSMR shows the ratio of observed to predicted deaths. It is therefore possible for an HSMR to fall whilst death rates increase. For this reason HSMRs should be considered alongside crude death rates which are useful for getting an overall picture of the number of deaths relative to the population.

Trends in crude underlying population mortality rates have been derived from the total number of deaths (numerator), and mid-year population estimates (denominator), both available from the National Records of Scotland at Scotland level and by NHS Board of residence.

Chart 9 shows the trend in overall population mortality for Scotland between April to June 2007 and January to March 2017. The series, although exhibiting seasonal characteristics, demonstrates a general downward trend in overall mortality, which has started to level off in recent quarters.

Chart 9: Underlying Population Death Rates (crude rates per 1,000 population); Scotland, Apr-Jun 2007 to Jan-Mar 2017p

The data relating to this chart can be found in Table A2b
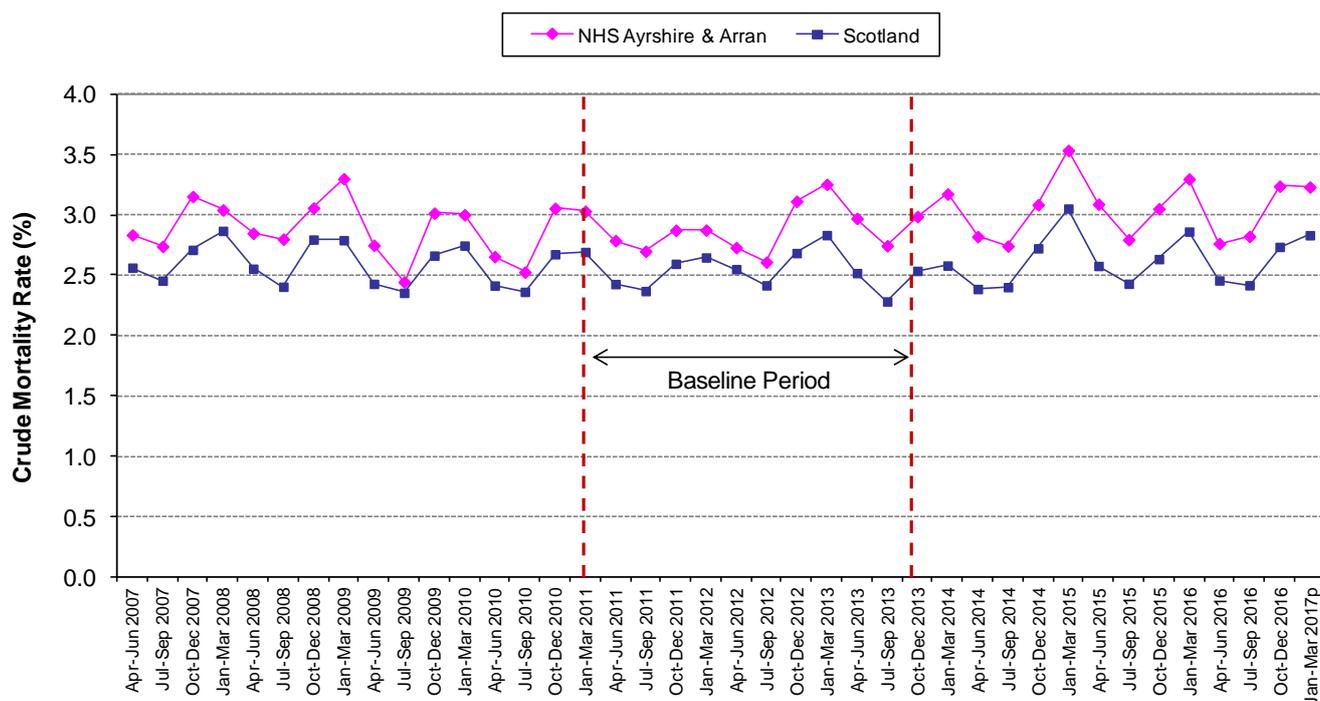
p - Provisional (see Appendix A3 - Data Quality and Timeliness)

TableA2b provides a series of mortality charts for the resident populations of each NHS Board area.

Data Files

The latest NHSScotland data from quarters ending March 2017 and comparable information by NHS Board of treatment and Hospital are given in the Excel files that accompany this publication. Please note the following.

Table A1a & Table A1b

The data within Table A1a and Table A1b contains a 'drop-down' selection option for NHSScotland combined and a choice of any of the (a) NHS Boards or (b) SPSP participating hospitals. The following series of tables and charts are presented.

- Table 1: Observed deaths, predicted deaths, hospital standardised mortality ratio, number of patients and crude mortality rate.
- Chart1: Hospital standardised mortality ratio for all hospitals in Scotland, and for a selected NHS Board or hospital from the list in Table 1.
- Chart2: Hospital standardised mortality ratio with regression line for a selected NHS Board or hospital from the list in Table 1.
- Chart 3a: Number of observed and predicted deaths in Scotland.
- Chart 3b: Number of observed and predicted deaths for a selected NHS Board or hospital from the list in Table 1.
- Chart 4: Crude Mortality Rates (%) for a selected NHS Board or hospital from the list in Table 1.

Table A1c

For each NHS Board SPSP participant hospital Table A1c presents:

- Funnel plots for each quarter since January to March 2016, allowing comparisons to be made between each hospital and the average for Scotland for that particular period.
- Run & Control Charts for a selected hospital using 'drop-down' selectors.

Table A1a, A1b and A1c contain macros and can be viewed using Microsoft EXCEL. Users should ensure that their macro security settings are set to enable this content to be viewed.

These results have also been published in an interactive dashboard format. A link to the latest dashboard is available on the HSMR webpage.

Table A2a

The data within Table A2a provides long term crude mortality demographics for NHSScotland. The following series of tables and charts are presented.

- Chart 3: Overall crude mortality rates (%) for deaths within 30-days of admission
- Chart 4: Overall crude mortality rates (%) for deaths within 30-days of admission by type of admission
- Chart 5: Overall crude mortality rates (%) for deaths within 30-days of admission by age group
- Chart 6: Overall crude mortality rates (%) for deaths within 30-days of admission by sex
- Chart 7: Overall crude mortality rates (%) for deaths within 30-days of admission by deprivation

Table A2b

The data within Table A2b contains a 'drop-down' selection option for NHSScotland combined and a choice of any of the NHS Boards of Treatment. The following series of tables and charts are presented.

- Table 1: Observed deaths within 30-days of ultimate hospital **discharge**, number of patients and crude mortality rate.

- Chart 8: Crude mortality rates (%) within 30-days of ultimate hospital discharge for a selected NHS Board.
- Table 2: Observed deaths (All Deaths) and crude population mortality rate.
- Chart 9: Crude population mortality rates (%) for a selected NHS Board.

Table 2

For each NHS Board SPSP participant hospital Table 2 shows the current HSMR and the overall percentage change since Jan-Mar 2014 (first quarter after baseline), using regression line values.

Table 3

For each SPSP participating hospital in Scotland Table 3 shows the impact of the data refresh on the previously published provisional Standardised Mortality Ratio.

Refinements to HSMR Methodology

Since the HSMR statistics were first released in 2009, extensive dialogue with stakeholders identified that there may be features of the HSMR model that could be refined and potentially improved upon. However, opportunity to implement such improvements needed to be balanced against the overall policy strategy, which was the continuation of the measure to end December 2015 to support the current phase of the Scottish Patient Safety Programme.

During 2015/16 ISD undertook to fully review the model methodology. As a result of this review ISD made the following recommendations to update the model methodology following the end of the current phase of the SPSP:

- Re-base the model on a more frequent basis, ensuring that the predicted mortality used within the HSMR calculation is based on more up to date data.
- Update the Charlson Index weightings used to calculate co-morbidity & prior morbidity weightings.
- Update the primary diagnosis groupings using the 140 Clinical Classification System categories as used in the Summary Hospital Mortality Indicator produced by the Health & Social Care Information Centre).
- Add co-morbidities and Scottish Index of Multiple Deprivation to the explanatory variables used for case-mix adjustment.
- Move to using a logistic regression based model instead of a decision tree.

More details of the review work and recommendations are available in the HSMR Review Paper. A Technical Document is also available on how the HSMR is now calculated and describes the methodology used in more detail.

Next Update

The next update, reporting on admissions to 30th June 2017, will be published on Tuesday 21 November 2017.

Glossary

HSMR	Hospital Standardised Mortality Ratio
NRS	National Records for Scotland (formerly General Register Office for Scotland)
SHMI	The Summary Hospital-level Mortality Indicator (SHMI) is an indicator which reports on mortality at trust level across the NHS in England. It is produced and published quarterly as an official statistic by the Health and Social Care Information Centre (HSCIC).
SIMD	Deprivation for individuals is estimated from aggregate data derived from the census and other routine sources. These are used to estimate the deprivation of small geographical areas. The Scottish Index of Multiple Deprivation (SIMD) has seven domains (income, employment, education, housing, health, crime, and geographical access, which have been combined into an overall index to pick out area concentrations of multiple deprivation.
SMR	Scottish Morbidity Record.
SMR(01)	SMR containing non-obstetric and non-psychiatric inpatient and day case activity.
SPSP	The Scottish Patient Safety Programme (SPSP) is a national programme that aims to improve the safety and reliability of healthcare and reduce harm, whenever care is delivered. The SPSP is led by Healthcare Improvement Scotland

List of Tables

Name	Time period	File & size
Table A1a (Hospital Standardised Mortality Ratios by NHS Board of Treatment; Jan-Mar 2011 to Jan-Mar 2017)	January 2011 – March 2017	Excel [239kb]
Table A1b (Hospital Standardised Mortality Ratios by Hospital; Jan-Mar 2011 to Jan-Mar 2017)	January 2011 – March 2017	Excel [287kb]
Table A1c (Hospital Standardised Mortality Ratios by Hospital, presented using SPC Charts; Jan-Mar 2011 to Jan-Mar 2017)	January 2011 – March 2017	Excel [1,291kb]
Table A2a (Crude mortality rates (%) for deaths within 30-days of admission by subgroup; Apr-Jun 2007 to Jan-Mar 2017)	April 2007 – March 2017	Excel [382kb]
Table A2b (Crude 30-day mortality from discharge and Overall population crude mortality rates by NHS Board; Apr-Jun 2007 to Jan-Mar 2017)	April 2007 – March 2017	Excel [281kb]
Table 2 (Percentage Change in Standardised Mortality Ratios (regression line) for hospitals in Scotland between Jan-Mar 2014 and Jan-Mar 2017)	January 2014 – March 2017	Excel [36kb]
Table 3 (Impact of the data refresh on the previously published provisional Standardised Mortality Ratios for all hospitals in Scotland; Oct-Dec 2016)	October 2016 – December 2016	Excel [14kb]

Contact

Robyn Munro
Principal Information Analyst
Robyn.Munro@nhs.net
0131 275 6967

David Caldwell
Senior Information Analyst
David.Caldwell1@nhs.net
0131 275 7421

Alan Finlayson
Service Manager
Alan.Finlayson@nhs.net
0131 275 6271

Further Information

Further information can be found on the ISD website

NHS Performs

A selection of information from this publication is included in NHS Performs. NHS Performs is a website that brings together a range of information on how hospitals and NHS Boards within NHSScotland are performing.

Rate this publication

Please provide feedback on this publication to help us improve our services.

Appendices

A1 – Background Information

Methods Used to Calculate the HSMR

The HSMR is calculated for all acute inpatient and day case patients admitted to all specialties (medical and surgical). The calculation takes account of patients who died within 30 days from admission; that is, it includes deaths that occurred in the community (out of hospital deaths) as well as those occurring in-hospital.

The HSMR is calculated as:

HSMR = Observed Deaths / Predicted Deaths

To calculate the predicted deaths, a predicted probability of death within 30 days from admission was calculated for each patient based on the patient's primary diagnosis; specialty (medical or surgical); age; sex; where the patient was admitted from; the number and severity of prior morbidities in the previous (i) 12 months (ii) 5-years; the number and severity of co-morbidities on the admitting episode; the number of emergency admissions in the previous 12 months; whether admitted as an inpatient or day case; type of admission (elective / non-elective); and deprivation quintile.

To calculate the HSMR from the baseline year (re-based in August 2016 to January 2011 to December 2013) the predicted probabilities were calculated using data from January 2011 to December 2013. These probabilities were then applied to the data for January 2014 to the latest quarter. The predicted probabilities were then summed to hospital level in order to produce the predicted number of deaths. See HSMR Technical Document for more detailed information on the methodology.

In order to count the number of patients and deaths within each quarter the patient's last stay within each quarter was selected. The outcome (whether the patient was alive or dead within 30 days) and the variables used for case-mix adjustment were taken from the first episode of the stay. Patients with admissions in different quarters will be counted in each quarter. If a patient was admitted in one quarter but died in the subsequent quarter, any admissions in this latter quarter were excluded. This ensured that the analysis was patient-based, within quarter, and that deaths were counted only once.

There are a number of caveats to be considered and addressed in relation to whether the HSMR is a good indicator of quality. For example, the statistical model used to produce the HSMR does not take account of palliative care, and so changes over time in palliative care services could be expected to impact on the HSMR. In addition, the current model looks at deaths within 30 days of admission to hospital, which means that in-hospital deaths are not captured if the patient is in hospital for more than 30 days.

Funnel Plots

A funnel plot is a type of 'Statistical Process Control' chart that helps to show data at a particular point in time. Funnel plots in this report allow comparisons to be made between each hospital and the average for Scotland for a particular period.

The Chart below provides an illustration of a funnel plot. The rate of the process, the HSMR, is plotted on the vertical axis. The denominator, predicted deaths, is plotted on the horizontal axis.

There are three lines in the funnel plots in this report.

The first line in dark blue is the average for Scotland. Plotted on either side of the average are two sets of curved lines called control limits (red). The red control limits are plotted at three standard deviations from the average. Orange warning limits have also been plotted on the charts presented here, at two standard deviations from the average. In the example below data points presented as circles represent hospitals.

The limits are wider at the left hand side of the graph because the data points plotted here represent smaller hospitals which are made up of fewer observations and subject to greater variability. This means that smaller hospitals will appear towards the left hand side of the graph and larger hospitals towards the right.

Chart 3: Example Funnel Plot
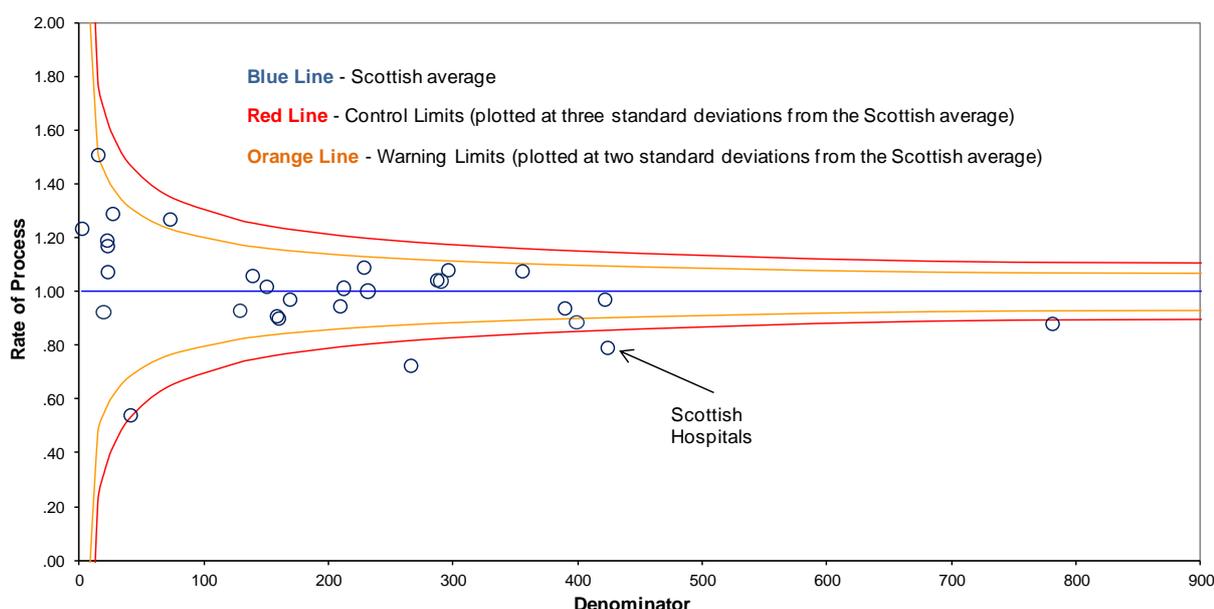
How to interpret a funnel plot

Data points out with the control limits (referred to here as 'outliers') are said to exhibit 'special cause variation'. Variations may reflect a number of factors, such as characteristics of the patients being cared for (case-mix), the quality of clinical care, errors in the data submitted by hospitals or even variation by chance. A single apparently high value of the HSMR is not sufficient evidence on which to conclude that a poor quality or unsafe service is being provided. This is why it is important not to focus solely on 'outliers' when making reliable judgements about the quality of patient care.

Inter-UK Comparisons: England and Wales

There is more than one measure routinely produced and used in England and Wales for the measurement of hospital mortality – HSMR and SHMI.

HSMR – England and Wales

What is now commonly referred to as HSMR indicator, was developed by Imperial College and is now routinely produced by Dr Foster Intelligence for England and Wales. This was a first for the UK in terms of national coverage and the development of the Scottish model was largely informed by the work done in England for this indicator.

For England and Wales there is a far greater emphasis, in the published HSMR data, on comparisons between a trust's HSMR and the national average than there is in Scotland. The Scottish approach is to focus on individual hospital trends and the aim of achieving a 10% reduction by December 2018. In Scotland mortality for each hospital is standardised to a fixed baseline period and individual patient risks therefore remain constant over time. This was re-based in August 2016. In England the SHMI model is re-calibrated every quarter so comparisons that are made against the average are appropriate and relevant for each point in time.

As a result, no direct comparison can be made between HSMRs for England and Scotland.

Summary Hospital-level Mortality Indicator (SHMI)

More recently other alternatives have become available, most notably the Summary Hospital-level Mortality Indicator (SHMI) (Department of Health / NHS Information Centre).

The SHMI was developed in collaboration with the Department of Health and overseen by an expert reference group. Its development followed publication of the first Francis report into Mid Staffordshire Hospital which included a recommendation for an NHS-owned and produced summary hospital mortality indicator.

Like the HSMR in Scotland, the SHMI is updated and published quarterly and is based on a statistical model developed from the national hospital dataset (equivalent to the SMR01 in Scotland), which calculates for each hospital how many deaths would be expected to occur if they were like the national average at that point in time.

The model takes into account a number of factors such as differences in age, sex, diagnosis, type of admission and other diseases (co-morbidity). This figure is then compared with the number of deaths that did occur in the hospital and the SHMI is the ratio between the two. SHMI acknowledges that there are unaccounted for factors affecting mortality in hospitals and recognition that there is random variation in the number of deaths as we do in Scotland. Chart 8 showed the crude mortality in Scotland over time according to the same definition as SHMI.

England and Wales SHMI and HSMR comparison

There are three key differences between the SHMI and the Dr Foster HSMR used in England and Wales

- The proportion of in-hospital deaths included in the index – this is all deaths in the SHMI but only 80% in the HSMR
- The inclusion of deaths outside acute hospitals in the SHMI but not in the HSMR
- The factors adjusted for vary between the two indicators

Comparison with Scotland

Regardless of the method, one message holds true for both the Scottish and English / Welsh approaches. That is, a high or higher than expected HSMR/SHMI should be a trigger for further investigation as on its own it cannot be taken to imply a poorly performing hospital or poor quality of care nor can it rule out quality issues or high levels of avoidable mortality.

 A measure of uncertainty is calculated for the SHMI and the NHS Information Centre calculates statistical bands to help decide when the SHMI for any trust exceeds expected limits. There is a scientific debate about how best to calculate these bands, so two different methods have been used.

In Scotland, we do not calibrate our model each quarter and publish the data with statistical bands around a national average. We do however, as part of our governance process, look at point in time comparisons against the national average using statistical methods in combination with a more subjective review of patterns in the trends backed-up by Statistical Process Control (run-chart) methodologies. See section on Quarterly Process for more information.

As there remains a subjective element to the assessment of when a communication should be triggered, work in Scotland is focused on developing a whole-system suite of indicators that includes HSMR underpinned by a set of statistical /subjective rules and formal multi-agency governance arrangements involving ISD, HIS and Scottish Government.

One important difference between the SHMI and other publicly available measures of hospital mortality in England is the inclusion of deaths within 30 days of discharge wherever they occur, not just in the hospital. There are other differences such as the proportion of all in hospital deaths included, and factors taken into account in the statistical model.

In Scotland, the HSMR has focussed only on deaths within 30-days of admission (but includes deaths in the community). It differs therefore from both SHMI and Dr Fosters HSMR in that respect alone. Also the adjustment factored into the different models varies, although they are very similar in many respects.

Table 3 shows a summary of some of the key comparisons between the English and Scottish approaches.

Table 3: Key comparisons between the favoured methods for hospital mortality indicators in Scotland and England.

	Scotland (HSMR)	England and Wales Summary Hospital-level Mortality Indicator (SHMI)	England and Wales Dr Foster (HSMR)
Patients	One patient observation per spell (referred to in Scotland as a continuous inpatient stay) attributed to the admission hospital of the last spell of care prior to death.	One patient observation per spell attributed to the last acute trust prior to death.	One patient observation per spell attributed to each acute trust involved in care. Only patients with a diagnosis that falls within 56 diagnosis groups are included (~80% of all activity)
Deaths	Deaths within 30 days of admission to an acute hospital (wherever they occur) In-hospital deaths occurring beyond 30-days are excluded.	All deaths occurring in hospital And deaths within 30 days of discharge from acute hospital (wherever they occur)	All inpatient and day case deaths in hospital
Adjustments	CCS group (primary diagnosis)/ Specialty (medical or surgical) / age / sex / admitted from / number and severity of prior morbidities in the previous (i) 12 months (ii) 5-years / number and severity of co-morbidities on admitting episode / number of emergency admissions in the previous 12 months / inpatient or day case / type of admission (elective / non-elective)/ deprivation	Age/ sex/ admission type/ CCS group (diagnosis) / comorbidity (modified Charlson score)	Age/ sex/ admission type/ CCS group (diagnosis) / comorbidity (modified Charlson score)/ deprivation/ previous emergency admissions / palliative care (specialty code 315; ICD10 code Z515/source of admission)

A2 - Quarterly Process

Since the first release of quarterly HSMR statistics to NHS Boards across Scotland in December 2009, a pattern of analysis and reporting coupled with cross agency governance procedures has been established.

There are three key stages to this quarterly process which include other indicators of quality.

Stage One: HSMR Management Information Tool

The initial production of the HSMR Management Information Tool involves the systematic review of the data by representatives from ISD and HIS. The purpose of the review is to identify potential patterns in the data and to initiate a dialogue with NHS Boards where appropriate. As the emphasis remains on local ownership of the data, a guidance document has been prepared jointly by Healthcare Improvement Scotland, the Information Services Division, Scottish Patient Safety Programme, and the Quality Improvement Hub.

By releasing information via the management tool first, NHS Boards have an opportunity to gain a greater understanding of some of the implications of the fairly complex adjustments that were applied in the model and to reconcile this with their own local data and intelligence.

Stage Two: Official Statistics Publication of HSMR for Scotland

The first Official Statistics release of the information was in June 2010, when a set of abbreviated summary tables were published on a dedicated website and linked to the main ISD site. The timing of the publication has been altered to better synchronise with the availability of death data from National Records of Scotland and to optimise the timeliness of reporting. See the section on Timeliness for further information.

The publication has been expanded to include more substantial commentary and context, including a look at stratified patterns of mortality at Scotland level and longer-term trends. There is also more commentary on the evolution of the measure in Scotland; where it came from, where we are now and where we are headed. We also take a more comprehensive look at how the Scottish HSMR compares to similar measures in other parts of the UK.

Stage Three: Hospital Scorecard

The Hospital Scorecard is a management information product commissioned by the Scottish Government's Directorate for Health Performance and Delivery. The scorecard incorporates HSMR with a series of other indicators, some of which are already routinely published. The other indicators are readmissions, length of stay, hospital acquired infection rates, A&E waiting times and patient experience. The purpose of the scorecard is to provide an overview with different indicators synchronised to a common point in time. A major benefit of using a scorecard approach is that it addresses concerns raised about governance processes based on the review of HSMR alone.

A summary of the processes and key dates for the latest quarterly cycle is shown in the table below.

Month	Processes and Key Dates

July	• Source database refreshed (14 July 2017)
	• Analytical work begins, involving
	    o Extraction of quarterly patient observations with outcome
	    o Mapping of predictions from baseline model
	    o Calculation of observed & predicted deaths at Hospital-level calculated by aggregating outcomes and predictions
	    o Import to reporting template
	    o Internal QA and data scrutiny (data completeness)
	• Review meeting with Healthcare Improvement Scotland (27 July 2017)
	• Management Information Tool made available to NHS Boards (28 July 2017)

August	• Official statistics report production cycle commences • Scottish Government and NHS Boards receive standard pre-release access (15 August 2017) • ISD briefs Scottish Government on content of report (16 August 2017) • Report published on ISD website at 09:30 on Tuesday 22 August 2017.
September	• Hospital Scorecard (containing HSMR and suite of additional indicators) released to Scottish Government's Directorate for Health Performance and Delivery (date tbc) • Scottish Government and HIS briefed by ISD on analytical data issues and interpretation of the scorecard • Scorecard presented to Scottish Government Health & Social Care Management Meeting (date tbc)

Throughout the quarterly cycle, interaction with NHS Boards is of paramount importance. There has been dialogue with the majority of NHS Boards since HSMRs were first released. This has been through a number of routes, including SPSP learning sessions, the QI Hub, or through the formal escalation process.

A3 - Data Quality and Timeliness

HSMR is being used extensively across Scotland as one of a number of indicators of quality and safety. The credibility of the HSMR is dependent on robust data quality, particularly around the accuracy and consistency of the recording of main diagnosis.

Source Data

The HSMR measure is derived from the routine returns that hospitals submit to the information Services Division for their non-obstetric and non-psychiatric inpatient and day case activity (known as the SMR01 dataset). ISD have well established mechanisms to work with providers to ensure the quality of the SMR01 records is maintained and where necessary enhanced.

The data is submitted to ISD on a monthly basis and are retrospectively linked together at patient-level. The hospital patient-profiles are then linked to the NRS death records on a monthly basis. During interaction with NHS Boards ISD has found that widespread use of the HSMR has drawn the focus of attention to the quality of data and clinical coding.

Data Quality Assurance

In August 2016, ISD published the findings of their most recent quality assurance assessment which was undertaken during 2014-15 to ensure that SMR01 (General / Acute Inpatient and Day Case) data items are being recorded consistently and to a high standard throughout NHS Scotland. The report shows that:

- main condition (used as a fundamental part of the HSMR calculation) is being recorded with an accuracy rate of 89%;
- however, not all of the hospitals participating in the SPSP were included in the sample, and the sample included hospitals not participating in the SPSP
- Recommendations include an improved and increased recording of conditions identified as acute or background conditions affecting the management of the patient

Timeliness

The majority of hospital admission data will be complete for the latest quarter, however it should still be considered provisional on the basis that the source data are dynamic and additional hospital returns will come in and be reflected in future calculations of the HSMR for that quarter.

Death registrations from NRS are linked to hospital admissions in Scotland on a monthly basis. This has enabled the HSMR time series to be extended to include admissions up to 14 July 2017 in this release.

A new patient management system (TrakCare PMS) has been implemented in five NHS Boards:

- NHS Ayrshire & Arran
- NHS Borders
- NHS Grampian
- NHS Greater Glasgow & Clyde
- NHS Highland
- NHS Lanarkshire

ISD continues to work with PMS Consortium Boards on national outputs to ensure they meet national definitional and processing requirements.

All hospitals have HSMRs calculated for the most recent quarters based on their current levels of data completeness. All NHS Board HSMRs are based on completeness levels of 95% and above for January-March 2017.

HSMRs should therefore be interpreted within the context of changes over time to the denominator patient numbers. ISD continues to work with NHS Boards to assist in the resolution of any data submission issues.

For more information about SMR completeness: http://www.isdscotland.org/products-and-Services/Data-Support-and-Monitoring/SMR-Completeness/

Refreshing Previously Provisional Data

The previous report, published on 23rd May 2017, presented provisional data for October – December 2016 along with data completeness estimates for those hospitals undergoing PMS implementation. The data for that quarter has now been refreshed to reflect additional returns that have subsequently been submitted for that quarter. The impact of those further submissions suggests that, previous completeness estimation was appropriate, and at Scotland level the data were approximately 99% complete. The overall Scottish HSMR for October – December 2016 has remained the same at 0.94 (rounded to 2 decimal places).

Table 3 shows the impact of the refresh on the individual hospital level HSMRs. Completeness levels in the latest period for those NHS Boards undergoing PMS implementation is generally now consistent with levels observed for other NHS Boards.

The updated analysis suggests that completeness for the majority of all remaining hospitals during October – December 2016 is now in excess of 97%.

A4 – Publication Metadata (including revisions details)

Metadata Indicator	Description
Publication title	Hospital Standardised Mortality Ratios
Description	Quarterly release of HSMR trends at Scotland, NHS Board and Hospital levels between Jan-Mar 2011 and Jan-Mar 2017. Also includes analyses of crude mortality trends over the longer term between Apr-Jun 2007 and Jan-Mar 2017.
Theme	Health and Social Care, Mortality
Topic	Quality Indicators
Format	Web Publication
Data source(s)	SMR01 / NRS Death Registrations – Linked Database
Date that data are acquired	14th July 2017
Release date	Tuesday 22 August 2017
Frequency	Quarterly
Timeframe of data and timeliness	Quarterly reporting periods from Apr-Jun 2007 to Jan-Mar 2017 (one-quarter reporting lag)
Continuity of data	SMR01 has recorded data in current form since April 2007
Revisions statement	The publication contains a refresh of previously reported data to reflect additional source data that has been received since last publication.
Revisions relevant to this publication	This release of HSMR continues to use the updated methodology; it is not comparable to previous releases using the old methodology.
Concepts and definitions	Contains sections on Data Source, Methodology and Development
Relevance and key uses of the statistics	Quality improvement and assurance.
Accuracy	Quality assured by NHS Boards (management information version of reports) and ISD
Completeness	Approximately 99% for the latest quarter.
Comparability	Contains section on inter-UK comparisons, data not directly comparable with similar measures used in England.
Accessibility	It is the policy of ISD Scotland to make its web sites and products accessible according to published guidelines.
Coherence and clarity	Measures to enhance coherence and clarity within this report include: explanatory chart/table notes, minimal use of abbreviations/abbreviations explained in text, comprehensive notes on background and methodology.
Value type and unit of measurement	Ratio of observed over predicted deaths (HSMR) Crude and Standardised Mortality (expressed as percentage of patients that die within 30-days of admission)
Disclosure	The ISD protocol on Statistical Disclosure Protocol is followed.
Official Statistics designation	Official Statistic
UK Statistics Authority Assessment	Assessment report published (ref no. 249). Confirmed as National Statistics April 2014
Last published	Tuesday 23rd May 2017
Next published	Tuesday 21st November 2017
Date of first publication	June 2010

Help email	NSS.isdQualityIndicators@nhs.net
Date form completed	3rd August 2017

A5 – Early Access details (including Pre-Release Access)

Pre-Release Access

Under terms of the "Pre-Release Access to Official Statistics (Scotland) Order 2008", ISD are obliged to publish information on those receiving Pre-Release Access ("Pre-Release Access" refers to statistics in their final form prior to publication). The standard maximum Pre-Release Access is five working days. Shown below are details of those receiving standard Pre-Release Access.

Standard Pre-Release Access:

> Scottish Government Health Department
>
> NHS Board Chief Executives
>
> NHS Board Communication leads

Early Access for Management Information

These statistics will also have been made available to those who needed access to 'management information', ie as part of the delivery of health and care:

NHS Health Board	Standard Pre-Release Access
Ayrshire & Arran	Clinical Improvement Manager
Borders	Director of Nursing Patient Safety Programme Manager
D&G	Nurse Director and Director for Patient Safety
Dumfries & Galloway	Patient Safety & Improvement Manager
Fife	Patient Safety Programme Manager
Forth Valley	Director of Nursing Head of Clinical Governance
Golden Jubilee	Clinical Governance Manager Director of Nursing & Clinical Services
Grampian	Nurse Director SPSP Programme Manager
Greater Glasgow & Clyde	Head of Clinical Governance
Highland	Head of Quality Health Intelligence Specialist
HIS	Executive Clinical Director Consultant in Public Health Medicine 2x Health Improvement Advisors
Lanarkshire	Head of Clinical Governance and Risk Management Patient Safety Manager 2x Quality Facilitators
Lothian	Consultant in Public Health SPSP Programme Manager
NHS Ayrshire and Arran	Assistant Director (Healthcare Quality, Governance and Standards) Associate Medical Director
NHS Lothian	Associate Medical Director

Orkney	Clinical Governance & Risk Management Lead
Shetland	Director of Pharmacy
	Programme Manager - 18 Weeks / SPSP
	Senior Planning & Information Officer
Tayside	Patient Safety Co-ordinator
	Patient Safety Development Manager
Western Isles	Nurse Director & Director of Patient Safety
	SPSP Programme Manager

Early Access for Quality Assurance

These statistics will also have been made available to those who needed access to help quality assure the publication: n/a.

A6 – ISD and Official Statistics

About ISD

Scotland has some of the best health service data in the world combining high quality, consistency, national coverage and the ability to link data to allow patient based analysis and follow up.

Information Services Division (ISD) is a business operating unit of NHS National Services Scotland and has been in existence for over 40 years. We are an essential support service to NHSScotland and the Scottish Government and others, responsive to the needs of NHSScotland as the delivery of health and social care evolves.

Purpose: To deliver effective national and specialist intelligence services to improve the health and wellbeing of people in Scotland.

Mission: Better Information, Better Decisions, Better Health

Vision: To be a valued partner in improving health and wellbeing in Scotland by providing a world class intelligence service.

Official Statistics

Information Services Division (ISD) is the principal and authoritative source of statistics on health and care services in Scotland. ISD is designated by legislation as a producer of 'Official Statistics'. Our official statistics publications are produced to a high professional standard and comply with the Code of Practice for Official Statistics. The Code of Practice is produced and monitored by the UK Statistics Authority which is independent of Government. Under the Code of Practice, the format, content and timing of statistics publications are the responsibility of professional staff working within ISD.

ISD's statistical publications are currently classified as one of the following:

- National Statistics (ie assessed by the UK Statistics Authority as complying with the Code of Practice)
- National Statistics (ie legacy, still to be assessed by the UK Statistics Authority)
- Official Statistics (ie still to be assessed by the UK Statistics Authority)
- other (not Official Statistics)

Further information on ISD's statistics, including compliance with the Code of Practice for Official Statistics, and on the UK Statistics Authority, is available on the ISD website.

The United Kingdom Statistics Authority has designated these statistics as National Statistics, in accordance with the Statistics and Registration Service Act 2007 and signifying compliance with the Code of Practice for Official Statistics. Designation can be broadly interpreted to mean that the statistics:

- meet identified user needs;
- are well explained and readily accessible;
- are produced according to sound methods, and
- are managed impartially and objectively in the public interest.

Once statistics have been designated as National Statistics it is a statutory requirement that the Code of Practice shall continue to be observed.