Hospital Standardised Mortality Ratio (HSMR)

Frequently Asked Questions

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HSMR

What is a Hospital Standardised Mortality Ratio?
An HSMR is a measure of mortality adjusted to take account of some of the factors known to affect the underlying risk of death.

The HSMR is based on all acute inpatient and daycase patients admitted to all specialties in Scottish hospitals. The calculation takes account of patients who died within 30 days from admission; and includes deaths that occurred in the community as well as those occurring in-hospital.

How is the HSMR calculated?
For a standard population (Scotland) during a baseline period the risk of dying for particular patient subgroups (e.g. age, sex, primary 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.

\[
\text{HSMR} = \frac{\text{Observed Deaths}}{\text{Predicted Deaths}}
\]

Example: If, using national data, we predicted 500 hospital deaths in Hospital Y, and the observed number of deaths was 450, then this would give Hospital Y an SMR of 450 / 500, which equals 0.90.

The patient sub-groups for which a risk of dying is calculated are 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 severity of comorbidities; the number of emergency admissions in the previous 12 months; whether admitted as an inpatient or daycase; type of admission (elective/ non-elective); and deprivation.

A three year dataset is used to calculate the risk. From August 2019 this will be a dynamic three year base period, advanced by three months with each reporting period. Prior to this a static base period covering the period January 2011 to December 2013 was used.
Changes in Methodology

Since the HSMR statistics were first released in 2009, ISD have periodically reviewed the model methodology to ensure that it continues to be robust and that comparisons which are made against the national average continue to be appropriate and relevant for each point in time.

The table below summarises the changes/ refinements that have been made since first release in 2009.

<table>
<thead>
<tr>
<th></th>
<th>2009 Model (Effective from December 2009)</th>
<th>2016 Model (Effective from August 2016)</th>
<th>2019 Model (Effective from August 2019 onwards)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Model</strong></td>
<td>Decision Tree</td>
<td>Logistic Regression</td>
<td>No Change</td>
</tr>
<tr>
<td><strong>Base Period</strong></td>
<td>October 2006 to September 2007</td>
<td>Three year dataset (January 2011 to December 2013)</td>
<td>Dynamic three year dataset, advanced by three months each reporting period.</td>
</tr>
<tr>
<td><strong>Reporting Period</strong></td>
<td>Quarter</td>
<td>Quarter</td>
<td>12 month period</td>
</tr>
<tr>
<td><strong>Explanatory Variables</strong></td>
<td>Age; Gender; Type of Admission (Elective/ Non-Elective); inpatient/ daycase; Where a patient was admitted from (e.g. Institution, Private residence; Temporary; Transfer); Number of Emergency Admissions in previous 1 year; Primary Diagnosis; Prior-morbidities in the previous 1 and 5 years; Specialty (Surgical/ Non-Surgical)</td>
<td>Age; Gender; Type of Admission (Elective/ Non-Elective); inpatient/ daycase; Where a patient was admitted from (e.g. Institution, Private residence; Temporary; Transfer); Number of Emergency Admissions in previous 1 year; Primary Diagnosis; Prior-morbidities in the previous 1 and 5 years; Co-morbidities; Specialty (Surgical/ Non-Surgical); Deprivation</td>
<td>Same as 2016 model with exception of “Specialty groupings” which have been expanded from two overarching groupings to more specific groupings.</td>
</tr>
<tr>
<td><strong>Primary Diagnosis Groupings</strong></td>
<td>26 based on medical intelligence and crude mortality rates</td>
<td>140 based on Clinical Classification Software (CCS) groupings.</td>
<td>No change</td>
</tr>
<tr>
<td><strong>Charlson Index</strong></td>
<td>2004 Australian Version of the Charlson Index (Sundararajan, et al., 2004)</td>
<td>Revised weightings based on work by Dr Foster Intelligence (Dr Foster Intelligence, 2014)</td>
<td>No Change</td>
</tr>
</tbody>
</table>

Please refer to the Research and Development webpage for more detailed information.
**Can HSMRs calculated using different methodologies be compared?**

No. HSMRs published using different methodologies described above are not comparable due to the different base periods and subgroups used to calculate the risk of dying.

The HSMR for Scotland (standard population) is re-set to 1.0 for each new baseline period. As hospital SMRs are relative to Scotland they will also adjust in line with this. The absolute value of HSMR will therefore change. This reflects the adjustment to the baseline population only, and is not an indication of a change in medical practice.

**Why has the methodology changed?**

The original HSMR methodology was agreed in 2009. The purpose of the HSMR at that time was to measure change in mortality over time, and to enable acute hospitals to monitor their progress towards the Scottish Patient Safety Programme (SPSP) aim of reducing hospital mortality by 20% by December 2015, subsequently extended to a further 10% by December 2018.

Following the end of these phases of the SPSP, the opportunity was taken to review the model methodology and subsequently update/refine it. This was to ensure that the methodology continued to be robust and that comparisons which are made against the national average continue to be appropriate and relevant for each point in time. HSMRs calculated using the updated methodologies are not comparable to those calculated previously.

**Were the methodologies used previously wrong?**

No. Since the HSMR statistics were first released in 2009, ISD have periodically reviewed the model methodology to ensure that it continues to be robust and that comparisons which are made against the national average continue to be appropriate and relevant for each point in time.

Any improvements need to be balanced against the overall policy strategy and purpose of the HSMR which, since 2016, was to monitor progress towards the Scottish Patient Safety Programme aim of reducing mortality.
Interpretation

What does it mean if an HSMR value is greater or less than 1?
The HSMR value for Scotland for the baseline period is 1.0. This allows hospital values to be compared to the Scottish average for each point in time.

- If an HSMR value is less than 1: 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 1: This means the number of deaths within 30 days for a hospital is more than predicted.

However, if the number of deaths is more than predicted (HSMR is more than 1) this does not necessarily mean that these were avoidable deaths (i.e. that they should not have happened at all), or that they were unexpected, or attributable to failings in the quality of care. Whether or not a death could have been avoided can only be determined by a detailed case-note review.

Similarly, a lower than predicted HSMR should not immediately be interpreted as indicating good performance. The HSMR requires careful interpretation and should be used in conjunction with other indicators and information from other sources.

What does a high HSMR mean?
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 instead be regarded as a trigger for further investigations.

What is a Statistical Process Control Chart, and why are these used?
Statistical Process Control (SPC) techniques, when applied to measurement data, can be used to highlight areas that would benefit from further investigation. These techniques enable the user to identify variation within their process. Understanding this variation is the first step towards quality improvement. We present HSMR and crude mortality data using three types of SPC chart to help identify variation. These are funnel plots, run charts and control charts.

Can HSMRs be compared between hospitals?
No. HSMRs are valid for comparing to the national average (Scotland) at each point in time only. It is not appropriate to make comparisons between hospitals as the frequency of risk groups (e.g. age, sex, primary diagnosis, type of admission, number and severity of co-morbidities etc.) will differ between hospitals.
Other FAQs

Does the Scottish HSMR capture all in-hospital deaths?
The Scottish HSMR calculation takes account of patients who died within 30 days from hospital admission. This means that the HSMR includes deaths that occurred in the community (out of hospital deaths) as well as those occurring in-hospital. However, the Scottish HSMR is not a measure of all in-hospital mortality because it does not include patients that die in-hospital after 30 days from admission.

Does the model adjust for palliative care patients?
A palliative care adjustment is not made in the national model. The specialty / significant facility of palliative medicine recorded on SMR01 would not capture all palliative cases. There is no information on the cancer registry for palliative cancer and although ISD has started to collect hospice data this is very incomplete.

How are transfers treated?
A patient can have more than one episode within a continuous inpatient stay, where there is a change in consultant or facility for example. A continuous inpatient stay (CIS) is defined as all episodes referring to the same continuous spell of inpatient treatment (whether or not this involves transfer between hospitals or even between NHS Boards). CISs are built up by examining the intervals between successive linked records for a given patient. Thus for each interval a decision is made as to whether the records constitute part of a continuous stay according to defined rules. Apart from the length of the interval between two records, decisions hinge on whether the type of discharge of the first record and type of admission on the second record is a transfer. A patient could have more than one stay within the time period, but as the stays for each person are linked any analysis can be at either patient or stay level.

With the Scottish HSMR the decision was taken to produce the analysis at patient level to eliminate double counting of patients and deaths. Therefore the analysis is at patient level indexing on the patient’s last stay in the reporting period. This means that only one death can be counted for each patient. Therefore, the outcome variable is calculated for each patient using the admission date of the first episode of the last stay and the date of death. For the explanatory variable the age, sex, deprivation, type of admission, inpatient/ day case, admitted from and primary diagnosis are also taken from the first episode of the patient’s last stay.

If the patient is seen in more than one hospital within a stay the outcome is counted against only the first hospital in the stay. Our clinical advisory group felt it was more appropriate to associate an outcome measure to the patient’s initial contact with inpatient or day case hospital services.

Which hospital is the outcome attributed to, the hospital on admission or discharge?
The outcome (whether the patient was alive or dead within 30-days) and the variables used for case mix adjustment are all taken from the first episode of the patients hospital stay. If the patient is seen in more than one hospital within a stay the outcome is counted against only the first hospital in the stay. This is because it was felt by clinicians that it was more
appropriate to associate an outcome measure to the patient’s initial contact with inpatient or day case hospital services.

**Is the Scottish HSMR directly comparable to those produced for English hospitals?**
Scottish HSMRs are not directly comparable to those produced for English hospitals. Although the method used in England by HSCIC and Dr Foster has informed the Scottish process, the models are different and reflect differences in the source data.

**Why is the latest reported figure always provisional?**
All hospitals have HSMRs calculated for the most recent time period based on their current levels of data completeness. Although diminishing, there remains a degree of data deficit; HSMRs should therefore be interpreted within the context of changes over time to the denominator patient numbers.

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

**What factors would influence HSMR values?**
There are a number of factors which influence HSMR, these include:

- 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. It may be reasonable to assume that those 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.

**Further Information**
Please refer to the Research and Development section of the website for further information.

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