Indicator Reference No:	I00699
Version:	1.19
Issue Date:	10th June 2015
Author:	Clinical Indicators Team
Directorate:	Information Services
Clinical Code Source:	Agency for Healthcare Research and Quality (AHRQ)

Indicator Specification:

Summary Hospital-level Mortality Indicator

Document Management

Every effort has been made to ensure that this specification is definitive and clearly states the methodology which the Health and Social Care Information Centre (HSCIC) will follow from the stated data sources. In the event that there is an error or omission in the written content of this specification, it will be updated under full version control and the new version republished on the HSCIC website.

As part of the Indicator Assurance Process, this methodology will be subject to periodic review. If you have any questions, comments or views on how this methodology could be improved, please contact the Clinical Indicators Team at the HSCIC (quoting 'SHMI' in the subject of your email) who will work with you to ensure your comments are incorporated into the next review.

Contact Information

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Review Details

No.	Version	Date	Reviewer

Comments

We welcome comments and queries on the methodology detailed by this specification. Please email them to enquiries@hscic.gov.uk (quoting 'SHMI' in the subject of your email). They will be acknowledged and incorporated into the next review of this methodology.

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Version History

Version	Date	Details
1.0	29th July 2011	First release
1.1	23rd August 2011	Amends following initial public review.
1.2	24th August 2011	• Clarification of the handling of R codes and the derivation of DIAG_GROUP. • Removal of references to the number of diagnosis groups.
1.3	25th August 2011	Adjustment to the exclusion of spells with unknown gender.
1.4	26th August 2011	Amendment of mental health trust list and clarification of the use of the first episode unless otherwise stated.
1.5	31st August 2011	Inclusion of Charlson method into specification in appendix E. Data periods changed to three years for model creation and one year for indicator scoring.
1.6	13th September 2011	• Updated Joining HES-ONS linked mortality data to HES provider spells dataset section for more clarity • Added new field YEAR_INDEX to facilitate year case-mix adjustment • Amended the SHMI Upper and Lower Limits calculation to be based on Expected • Added organisations to Mental Health Trusts and Community Hospitals exclusions list

1.7	13th October 2011	• Updated further Joining HES-ONS linked mortality data to HES provider spells dataset section for more clarity
		• Updated Risk Modelling specifications to include logistic regression options for model convergence
		• Amended the standardised residuals to be based on Expected for random effects model control limits
		• Updated SHMI Banding, Upper and Lower Limits and output table (6.1) to report on 2 bandings; exact Poisson control limits at a 99.8% level and random effects model control limits at a 95% level.
		• Updated Appendix C.1, removing from list
		  ○ Royal Free Hampstead
		  ○ Wrightington, Wigan and Leigh NHS Foundation Trust
		  ○ University College Hospital
		  ○ North West London NHS Trust
		• Updated to make use of P_SPELL_EPIORDER explicit.

1.8	25th October 2011	• Corrections made to the SHMI Upper and Lower Limits
1.9	17th January 2012	• Remove Appendix D: Gender Specific Diagnosis Groups • Exclude regular night attenders from dataset • Specify reference category as first category for all classification/case-mix variables for risk model • Appended new providers to Appendix C.2 • Updated the SHMI Bandings to only report on 1 banding: 95% random effects model control limits for over-dispersion
1.10	11th April 2012	• Appended new providers to Appendix C.2

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Version	Date	Details
1.11	11th July 2012	• Added fields needed for calculation of SHMI contextual indicators to the list of data fields • Added a link to the SHMI publication timetable in references • Specified that the dataset for calculating the contextual indicators is the same as that used for scoring the SHMI • Appended new providers to Appendix C.2 • Changed the SAS model fitting option from RIDGING=NONE to RIDGING=ABSOLUTE
1.12	10th October 2012	• Updated Appendix D.1 to reflect ICD-10 4th edition codes • Removed P_SPELL_DISDEST from list of data fields • Added IMD04RK to list of data fields, as this is required in the calculation of a new SHMI contextual indicator • Updated Introduction of Appendix D to improve clarity
1.13	14th January 2013	• Removed DEATH_RECORD_USED from list of data fields, as this is no longer used in the calculation of contextual indicator I00733 • Updated Data Filter and Pre Data Processing sections following the creation of the organisation 'R1F – Isle of Wight NHS Trust'
1.14	11th April 2013	• Appended new provider to Appendix C.2 • Updated with new HSCIC logo, links and contact details
1.15	15th January 2014	• Updated Appendix B.3 with changes made to admission method codes following the release of version 6.2 of the Commissioning Data Sets (CDS) • Updated summation notation to improve clarity • Updated description of indicator • Updated Document Management section • Updated description of which episode is used in the calculation of the Charlson Comorbidity Index in Appendix D to improve clarity • Added reference to mapping between ICD-10 codes and CCS groups, which is available to download from the HSCIC's SHMI homepage
1.16	10th April 2014	• Changed the reference category for the STARTAGE, ADMIMETH and GENDER case-mix variables to be the category with the highest number of records across the three year dataset for each diagnosis group
1.17	09th October 2014	• Removed P_SPELL_CHARLSON from list of source data fields, as this is a calculated field defined later in the document. • Updated the Risk Modelling section to state that records which have a missing or unknown value for the STARTAGE, ADMIMETH or GENDER variables are re-categorised to belong to the corresponding reference category for that variable and diagnosis group.
1.18	14th January 2015	• Added Table 6.2 explaining the calculation of the SHMI broken down by provider and diagnosis group, which will be published from the January 2015 SHMI publication onwards. • Added details of small number suppression used for SHMI data broken down by provider and diagnosis group. • Updated the descriptions in Table 6.1 to improve clarity.

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Version	Date	Details
1.19	10th June 2015	• Updated the rules for joining HES-ONS linked mortality data to the HES provider spells dataset for cases where there are multiple spells with the same maximum discharge date and added EPIKEY to the list of data fields required. • Removed provider RBB from the list of excluded trusts in Appendix C.1, as this provider has now merged with provider RD1.

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1. Overview

Indicator Family Name	Indicator Family Code	Indicator Code
Summary Hospital-level Mortality Indicator	SHMI	I00699

Categories
Mortality indicator Hospital care

Subject
Mortality indicator associated with hospitalisation

Detailed Descriptor
The Summary Hospital-level Mortality Indicator (SHMI) reports on mortality at trust level across the NHS in England using a standard and transparent methodology. The SHMI gives an indication of whether the mortality ratio of a trust is as expected, higher than expected or lower than expected when compared to the national baseline (England).

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2. Introduction

Reporting Frequency
• Model refresh required for quarterly reporting. • Model recalibrate required quarterly.

Description
The SHMI is a ratio of the observed number of deaths to the expected number of deaths for a trust (provider). The observed number of deaths is the total number of finished provider spells for the trust which resulted in a death either in-hospital or within 30 days (inclusive) of discharge from the trust. If the patient is treated by another trust within 30 days of discharge, their death is attributed to the last non-specialist acute trust to treat them. The expected number of deaths is calculated from a risk-adjusted model with a patient case-mix of age, gender, admission method, year index, Charlson Comorbidity Index and diagnosis grouping. A three year dataset is used to create the risk-adjusted models. A one year dataset is used to score the SHMI and to calculate the contextual indicators. For details of the time periods used for the model build and the scoring, please refer to the SHMI publications timetable [1]. The dataset used for the contextual indicators is the same as that used for the SHMI scoring.

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3. Data

Data Source
Hospital Episode Statistics (HES), provider spells level [2] Office for National Statistics (ONS) HES-ONS linked mortality data [3]

Data Fields
The data fields required for this indicator and the calculation of the SHMI contextual indicators are as follows: <u>HES provider spells</u> • HESID_MAPPED — Individual patient identifier • P_SPELL_NUMBER — Identifies unique provider spells • P_SPELL_START_AGE — Age of the patient at the start of the spell • CLASSPAT — Patient classification • SEX — Sex of patient • P_SPELL_ADMIMETH — Method of admission to hospital • P_SPELL_ADMIDATE — Admission date to hospital • DIAG_1 — Primary diagnosis code • DIAG_2 – DIAG_20 — Secondary diagnosis codes • P_SPELL_DISMETH — Discharge method for provider spell • P_SPELL_DISDATE — Discharge date for provider spell • PROCODET _MAPPED — Provider code for spell mapped to current providers • P_SPELL_FIRST_EPISODE — Identifies the first episode in a provider spell • P_SPELL_LAST_EPISODE — Identifies the last episode in a provider spell • P_SPELL_EPIORDER — Identifies the order of episodes with each spell • TRETSPEF — The specialty in which the consultant was working during the period of care • IMD04RK — The Index of Multiple Deprivation (IMD) overall rank • EPIKEY — Identifies unique episodes in a spell <u>HES-ONS linked mortality data</u> • HESID — Individual patient identifier • DOD — HES-ONS linked date of death

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Joining HES-ONS linked mortality data to HES provider spells dataset Filters

- HES provider spells dataset is filtered according to the following rules:

  Field Name: PROCODET_MAPPED

  Condition: a. OR b. defined as follows:

  a. Begins with 'R' except any of the provider codes listed in Appendix C.1 Specialist Hospitals AND Appendix C.2 – Mental Health Trusts and Community Hospitals

  b. Includes '5QT'

  Rationale: Condition a. selects acute trusts excluding Independent Sector providers, Mental Health Trusts, Community Hospitals and Specialist Acute Trusts.

  Condition b. includes 'Isle of Wight NHS Primary Care Trust'

  Field Name: P_SPELL_DISDATE

  Condition: the 36 month period + 30 days, as specified for the model build in the SHMI publication timetable [1]

  Rationale: This filter selects the 3 year dataset used to build the model, including an additional 30 days to ensure mortality events occurring in the 30 days post discharge are assigned to the correct provider spell

Joining HES-ONS linked mortality data to HES provider spells dataset Rules

- All discharge episodes from the filtered HES provider spells dataset are identified for joining using the field P_SPELL_LAST_EPISODE = 'Y'.
- The HES-ONS linked mortality dataset is joined to the HES provider spells dataset for each patient using the following rules:
  - Where a HESID has only one provider spell:
    - the HES-ONS linked mortality dataset is joined to the HES provider spells dataset using the HESID to HESID_MAPPED fields
  - Where a HESID has more than one provider spell:
    - the HES-ONS linked mortality dataset is joined to the HES provider spells dataset using the HESID to HESID_MAPPED fields and the provider spell with the latest (maximum) P_SPELL_DISDATE
  - Where a HESID has more than one provider spell and where multiple provider spells have the same latest (maximum) discharge date and only one of these spells has P_SPELL_DISMETH=4 (discharge method is died):
    - the HES-ONS linked mortality dataset is joined to the HES provider spells dataset using the HESID to HESID_MAPPED fields and the provider spell with the latest (maximum) P_SPELL_DISDATE and P_SPELL_DISMETH=4
  - Where a HESID has more than one provider spell and where multiple provider spells have the same latest (maximum) discharge date and either no spell has P_SPELL_DISMETH=4 (discharge method is died) or multiple spells have P_SPELL_DISMETH=4:
    - the HES-ONS linked mortality dataset is joined to the HES provider spells dataset using the HESID to HESID_MAPPED fields and the provider spell number with the latest (maximum) P_SPELL_DISDATE and the highest (maximum) EPIKEY

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4. Data Preparation

Definition of Event
For this indicator the *event* is defined as a death that occurred either in-hospital or within 30 days (inclusive) of being discharged from hospital. Condition: Both a. AND b. are true. Defined as follows: a. DOD – P_SPELL_DISDATE < 31 b. P_SPELL_ADMIDATE ≤ DOD Rationale: Condition b. prevents events being assigned where a patient is recorded as dead before their spell in hospital begins. Note: It is possible for condition a. to return a negative number. Possible causes for this are: the patient may have died late at night and the hospital were unable to record the discharge until the next day, or, the patient may have died on a previous day but was not released until tests were performed on a subsequent day [2]. 2 new variables *Died* and *Survived* are created. An *event* has occurred when *Died* = 1. *Died* = { 1 and *Survived* = 0 IF condition met; / 0 and *Survived* = 1 otherwise.

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Data Filter

The following data filters are applied to the first episode of the spell, identified by P_SPELL_FIRST_EPISODE = 'Y' of the HES Provider Spells level dataset.

Field Name:	P_SPELL_DISDATE
Condition:	For creating the risk model: the 36 month period specified in the SHMI publications timetable [1]. For scoring the indicator: the 12 month period specified in the SHMI publications timetable [1]. For the contextual indicators: the same dataset as for scoring the SHMI
Rationale:	This filter selects the 1 year dataset for scoring the SHMI and the contextual indicators, and the 3 year dataset for creating the risk model [1].

Field Name:	P_SPELL_DISMETH
Condition:	NOT equal to 5
Rationale:	This filter removes stillbirths from the dataset.
Note:	ONS include still births in their birth registrations dataset and not in death registrations. Therefore they are not recorded in the HES-ONS mortality dataset from the ONS data. HES death data added to the linked HES-ONS mortality dataset uses only DISMETH = '4' (Died). Stillbirths in HES are identified using the criteria of DISMETH = '5' (Baby was stillborn). Stillbirths are therefore not recorded in the HES-ONS mortality dataset.

Field Name:	CLASSPAT
Condition:	NOT equal to 2, 3 or 4
Rationale:	This filter removes patients admitted as day cases, regular day attenders and regular night attenders from the dataset.

Field Name:	PROCODET_MAPPED, P_SPELL_ADMIDATE
Condition:	PROCODET_MAPPED = '5QT' AND P_SPELL_ADMIDATE >= '01-Apr-2012'
Rationale:	This filter removes records for '5QT - Isle of Wight NHS Primary Care Trust' where P_SPELL_ADMIDATE is on or after 1st April 2012 from the dataset.
Note:	Prior to 1st April 2012, all activity for Isle of Wight was identified by the organisation code '5QT – Isle of Wight NHS Primary Care Trust'. From 1st April 2012, a new code 'R1F – Isle of Wight NHS Trust', was created following the transfer of provision of services from Isle of Wight NHS Primary Care Trust to Isle of Wight NHS Trust.

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Pre Data Processing

The following pre data processing is applied to the dataset.

Field Name: DIAG_1

Condition: For each provider spell, DIAG_1 is based on the primary diagnosis of the first episode. However, if the primary diagnosis of the first episode of the provider spell is an R code (chapter XVIII in the ICD-10 classification - Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified), DIAG_1 will then be based on the primary diagnosis from the second episode. If the primary diagnosis from the second episode is also an R code, DIAG_1 is then reverted to be based on the primary diagnosis from the first episode. P_SPELL_EPIORDER is used to identify the episode order.

Field Name: P_SPELL_CHARLSON

Condition: Where the second episode of the provider spell is used to derive the primary diagnosis, the secondary diagnosis fields from the second episode are used to calculate the Charlson Comorbidity Index. Otherwise, the secondary diagnosis fields from the first episode of the provider spell are used. Details of the calculation of P_SPELL_CHARLSON are provided in Appendix D: Charlson Comorbidity Index Calculation.

Field Name: P_SPELL_ADMIMETH

Formulae: If P_SPELL_ADMIMETH is <NULL> then SET P_SPELL_ADMIMETH = 99

Rationale: This condition sets all missing methods of admission to not known.

Field Name: SEX

Formulae: If SEX is <NULL> then SET SEX = 9

Rationale: This condition sets all missing sexes of patients to not specified.

Field Name: P_SPELL_DISDATE

Formulae:

$$\text{YEAR\_INDEX} = \begin{cases} 1 & \text{for the } 1^{st} \text{ most recent 12-month period in the dataset} \\ 2 & \text{for the } 2^{nd} \text{ most recent 12-month period in the dataset} \\ 3 & \text{for the } 3^{rd} \text{ most recent 12-month period in the dataset} \end{cases}$$

Rationale: This condition assigns an index to the 3 year dataset according to a 12-month period. New field name YEAR_INDEX.

Field Name: PROCODET_MAPPED

Formulae: If PROCODET_MAPPED = '5QT' then SET PROCODET_MAPPED = 'R1F'

Rationale: This condition maps activity for '5QT – Isle of Wight NHS Primary Care Trust' to 'R1F – Isle of Wight NHS Trust'.

Note: Prior to 1st April 2012, all activity for Isle of Wight was identified by the organisation code '5QT – Isle of Wight NHS Primary Care Trust'. From 1st April 2012, a new code 'R1F – Isle of Wight NHS Trust', was created following the transfer of provision of services from Isle of Wight NHS Primary Care Trust to Isle of Wight NHS Trust.

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Data Processing

The following 5 variables need to be re-categorised with 5 new variables created post categorisation. Details of the re-categorisation are provided in Appendix B.

- P_SPELL_START_AGE — Category numbers for this field are listed in Appendix B.1 – Age. New field name STARTAGE.
- P_SPELL_ADMIMETH — Category numbers for this field are listed in Appendix B.3 – Admission Method. New field name ADMIMETH.
- SEX — Category numbers for this field are listed in Appendix B.4 – Sex. New field name GENDER.
- DIAG_1 — Diagnoses in this field are recorded using ICD-10 codes [4]. These are assigned to CCS categories using the amended AHRQ CCS ICD-10 lookup table supplied by the Dr Foster Unit at Imperial College London [5]. These CCS categories are then grouped into diagnosis groups as detailed in Appendix A: CCS Diagnosis Groupings. New field name DIAG_GROUP.
- P_SPELL_CHARLSON — Category numbers for this field are listed in Appendix B.2 – Charlson Comorbidity Index. New field name CHARLSON_INDEX.

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Table 4.1 Output table for Risk Modelling

The final case-mix for the data is as follows:

- STARTAGE Age group
- CHARLSON_INDEX Charlson Comorbidity Index group
- ADMIMETH Admission method group
- GENDER Gender group
- YEAR_INDEX Year index

Each distinct combination of values for these variables defines a distinct case-mix *j*.

Table 4.1 shows the output data requirements aggregated by the case-mix for the data as listed above with identities DIAG_GROUP and PROVIDER needed for the risk modelling in the following section.

Field Name	Type	Length	Source/Details
INDICATOR_CODE	CHAR	6	As defined in Section 1. Overview
DIAG_GROUP	INT		Diagnosis group as defined in Appendix A – CCS Diagnosis Groupings
PROVIDER	CHAR	3	PROCODET_MAPPED field in original data
STARTAGE	INT		Age group as defined in Appendix B.1 – Age
CHARLSON_INDEX	INT		Charlson Comorbidity Index group as defined in Appendix B.2 – Charlson Comorbidity Index
ADMIMETH	INT		Admission method group as defined in Appendix B.3 – Admission Method
GENDER	INT		Gender group as defined in Appendix B.4 – Sex
YEAR_INDEX	INT		Year index indicating the 12-month period of the dataset as defined Section 4. Data Preparation, Pre-Data Processing
NUMERATOR	INT		$Numerator_{pdj} = \sum_i Died_{pdji}$ The sum of *Died* for provider *p* with diagnosis grouping *d* and case-mix *j* over all patients *i*
DENOMINATOR	INT		$Denominator_{pdj} = \sum_i Died_{pdji} + \sum_i Survived_{pdji}$ The sum of *Died* and *Survived* for provider *p* with diagnosis grouping *d* case case-mix *j* over all patients *i*

Table 4.1 – Output table for risk modelling

Note: INDICATOR_CODE will be the same for all records.

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5. Risk Modelling

Specifications

A risk model is built for each of the diagnosis groups using the three year dataset defined above.

A full main effects only logistic regression model with a logit link function is derived to calculate the risk of an *event* for each diagnosis group *d*.

The 1st category is used as the reference category for the CHARLSON_INDEX and YEAR_INDEX variables. The category with the highest number of records across the three year dataset for each diagnosis group is used as the reference category for the STARTAGE, ADMIMETH and GENDER variables.

Records which have a missing or unknown value for the STARTAGE, ADMIMETH or GENDER variables are re-categorised to belong to the corresponding reference category for that variable and diagnosis group.

The SAS Enterprise Guide model-fitting specification options RIDGING=ABSOLUTE and NOCHECK are used.

The independent case-mix variables for the risk model are:

- STARTAGE Age group at start of spell
- CHARLSON_INDEX Charlson Comorbidity Index group
- ADMIMETH Admission method group
- GENDER Gender group
- YEAR_INDEX Year index

Each distinct combination of values for these variables defines a distinct case-mix *j*

The response variable for the risk model is $\frac{Events_{dj}}{Trials_{dj}}$ where

$Events_{dj} = \sum_{p} Numerator_{pdj}$; the sum of *Died* observed for diagnosis group *d* and case-mix *j* over all providers *p*

$Trials_{dj} = \sum_{p} Denominator_{pdj}$; the sum of *Died* and *Survived* observed for diagnosis group *d* and case-mix *j* over all providers *p*

Calculation

The risk of an *event* is calculated for every case-mix combination *j* in all diagnosis groups *d* defined as

$Risk_{dj} = \frac{e^{\log odds_{dj}}}{1+e^{\log odds_{dj}}}$ where

$\log odds_{dj} = \alpha_d + \sum_{i=1}^{j} \beta_{di}\, x_i$; with intercept estimate α_d and case-mix estimates $\beta_{d1}, \ldots, \beta_{dj}$ for case-mix variables $x_1, \ldots, x_j$ with diagnosis grouping *d*

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6. Indicator Calculation

SHMI Calculation

The SHMI is calculated using the 1 year dataset defined above. For each provider *p* the SHMI is defined as $SHMI_p = \frac{Observed_p}{Expected_p}$ where

$Observed_p = \sum_d \sum_j Numerator_{pdj}$; the sum of *Died* observed for provider *p* over all diagnosis groups *d* and case-mixes *j*

$Expected_p = \sum_d \sum_j \left(Risk_{dj} \times Denominator_{pdj}\right)$; the sum of the product of *Risk* and *Denominator* observed for provider *p* over all diagnosis groups *d* and case-mixes *j*

SHMI Banding

There will be 1 published SHMI banding for providers;

- *OD_BANDING*; 2 standard deviations (2SD) from the target, corresponding to a 95% control limit derived from a random effects model [6][7] applying a 10% trim from the top and bottom of all providers for over-dispersion

Upper and lower control limits are calculated for each provider *p* based on the target, $Expected_p$ and the bandings assigned as follows:

$$OD\_BANDING_p = \begin{cases} 1 & \text{if } SHMI_p \text{ is greater than } OD\_UL_p; \\ 2 & \text{If } SHMI_p \text{ is between } OD\_LL_p \text{ and } OD\_UL_p \text{ inclusive;} \\ 3 & \text{if } SHMI_p \text{ is less than } OD\_LL_p; \end{cases}$$

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SHMI Upper and Lower Control Limits

There will be 2 SHMI upper and lower control limits which providers will be compared against:

- Random effects model applying a 10% trim

  The standardised Pearson residual Z is derived assuming

  the standard error (SE) of $\log_e SHMI = \frac{1}{\sqrt{Expected}}$;

  Trimming is based on the standardised Pearson residual Z for each provider p excluding the top and bottom 10% of the scores from the calculation of the upper and lower limits, defined as $Z_p = \sqrt{Expected_p} \times \log_e SHMI_p$

  The Upper and Lower limits, OD_UL_p and OD_LL_p are defined as $e^{\left(z_\alpha \sqrt{\frac{1}{Expected_p} + \tau^2}\right)}$ where

  z_α = $z_{0.025}$; Standard score for Lower limit of 2SD prediction interval

  $z_{0.975}$; Standard score for Upper limit of 2SD prediction interval

  τ^2 = over-dispersion parameter defined as $\frac{N^* \Phi - \left(N^* - 1\right)}{\sum_i Expected_i^* - \sum_i \left(Expected_i^*\right)^2 \Big/ \sum_i Expected_i^*}$

  with N^* = remaining number of providers after trimming;

  $Expected_i^*$ = remaining number of expected events after trimming;

  Φ = over-dispersion factor defined as $\frac{1}{N^*} \sum_i \left(Z_i^*\right)^2$ with

  N^* = remaining number of providers, p after trimming;

  Z_i^* = remaining standardised Pearson residual after trimming.

- Exact Poisson distribution

  The Upper and Lower limits, PO_UL_p and PO_LL_p are derived from a 99.8% control limit from an exact Poisson distribution [8] based on the target, $Expected_p$.

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Table 6.1 – Output table for SHMI data at provider level

Table 6.1 provides details of the output data from the indicator calculations aggregated by PROVIDER.

Field Name	Type	Length	Source/Details
INDICATOR_CODE	CHAR	6	As defined in Section 1. Overview
PROVIDER	CHAR	3	PROCODET_MAPPED field in original data
DENOMINATOR	INT		$Denominator_p = \sum_d \sum_j Died_{pdj} + \sum_d \sum_j Survived_{pdj}$ The sum of *Died* and *Survived* for provider *p* over all diagnosis groups *d* and case-mixes *j*
OBSERVED	INT		$Observed_p$, the observed number of deaths for provider *p*, as calculated in Section 6. Indicator Calculation, SHMI Calculation
EXPECTED	FLOAT		$Expected_p$, the expected number of deaths for provider *p*, as calculated in Section 6. Indicator Calculation, SHMI Calculation
VALUE	FLOAT		$SHMI_p$, the SHMI value for provider *p* as calculated in Section 6. Indicator Calculation, SHMI Calculation
PO_LL	FLOAT		PO_LL_p, the lower 99.8% Poisson control limit for provider *p*, as calculated in Section 6. Indicator Calculation, SHMI Upper and Lower Limits
PO_UL	FLOAT		PO_UL_p, the upper 99.8% Poisson control limit for provider *p*, as calculated in Section 6. Indicator Calculation, SHMI Upper and Lower Limits
OD_LL	FLOAT		OD_LL_p, the lower 95% control limit adjusted for over-dispersion for provider *p*, as calculated in Section 6. Indicator Calculation, SHMI Upper and Lower Limits
OD_UL	FLOAT		OD_UL_p, the upper 95% control limit adjusted for over-dispersion for provider *p*, as calculated in Section 6. Indicator Calculation, SHMI Upper and Lower Limits
OD_BANDING	INT		$OD\_Banding_p$, the SHMI banding for provider *p*, as calculated in Section 6. Indicator Calculation, SHMI Banding

Table 6.1 – Output table for SHMI data at provider level

Note: INDICATOR_CODE will be the same for all records.

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Table 6.2 – Output table for SHMI data at provider and diagnosis group level

Table 6.2 provides details of the output data from the indicator calculations aggregated by PROVIDER and DIAGNOSIS GROUP.

Field Name	Type	Length	Source/Details
INDICATOR_CODE	CHAR	6	As defined in Section 1. Overview
DIAGNOSIS GROUP	INT		Diagnosis group as defined in Appendix A – CCS Diagnosis Groupings
PROVIDER	CHAR	3	PROCODET_MAPPED field in original data
DENOMINATOR	INT		$Denominator_{pd} = \sum_j Died_{pdj} + \sum_j Survived_{pdj}$ The sum of *Died* and *Survived* for provider *p* and diagnosis group *d* over all case-mixes *j*
OBSERVED	INT		$Observed_{pd} = \sum_j Numerator_{pdj}$ The observed number of deaths for provider *p* and diagnosis group *d* over all case-mixes *j*
EXPECTED	FLOAT		$Expected_{pd} = \sum_j (Risk_{dj} \times Denominator_{pdj})$ The expected number of deaths for provider *p* and diagnosis group *d* over all case-mixes *j*

Table 6.2 – Output table for SHMI data at provider and diagnosis group level

Note: INDICATOR_CODE will be the same for all records.

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Small Number Suppression

The following small number suppression is applied to the SHMI data at provider and diagnosis group level:

Primary Suppression:

Field Name: $Denominator_{pd}$

Condition: IF $Denominator_{pd} < 6$ AND $Denominator_{pd} > 0$
THEN $Denominator_{pd} = *$

Field Name: $Observed_{pd}$

Condition: IF $Observed_{pd} < 6$ AND $Observed_{pd} > 0$
THEN $Observed_{pd} = *$

Rationale: Small number suppression is applied to the number of finished provider spells and observed deaths at provider and diagnosis group level for the purposes of disclosure control. Where the number of finished provider spells for a particular provider and diagnosis group is not zero and less than 6, this value is suppressed with the special character *. Similarly, where the number of observed deaths for a particular provider and diagnosis group is not zero and less than 6, this value is suppressed with the special character *.

Secondary Suppression:

Field Name: $Expected_{pd}$

Condition: IF $Denominator_{pd}$ = * AND $Expected_{pd} >= 4$ and $Expected_{pd} <= 5$
THEN $Expected_{pd}$ = *

Rationale: The expected number of deaths for a particular provider and diagnosis group is constrained to be less than or equal to the number of finished provider spells. In cases where the expected number of deaths for a particular provider and diagnosis group is greater than or equal to 4 and less than or equal to 5 and the corresponding number of finished provider spells has undergone primary suppression then the expected number of deaths is also suppressed. Otherwise it can be inferred that the suppressed number of finished provider spells is equal to 5.

Field Name: $Denominator_{pd}$

Condition: If the values of $Denominator_{pd}$ that have been suppressed for a particular provider *p* are all equal to 1 then the smallest unsuppressed value of $Denominator_{pd}$ for provider *p* is also suppressed with the special character *. If there is more than one diagnosis group *d* with the same value of $Denominator_{pd}$ then the value with the lowest diagnosis group number *d* is chosen for secondary suppression.

Field Name: $Observed_{pd}$

Condition: If the values of $Observed_{pd}$ that have been suppressed for a particular provider *p* are all equal to 1 then the smallest unsuppressed value of $Observed_{pd}$ for provider *p* is also suppressed with the special character *. If there is more than one diagnosis group *d* with the same value of $Observed_{pd}$ then the value with the lowest diagnosis group number *d* is chosen for secondary suppression.

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Field Name:	$Denominator_{pd}$
Condition:	If the values of $Denominator_{pd}$ that have been suppressed for a particular diagnosis group *d* are all equal to 1 then the smallest unsuppressed value of $Denominator_{pd}$ for diagnosis group *d* is also suppressed with the special character *. If there is more than one provider *p* with the same value of $Denominator_{pd}$ then the first provider when the provider codes are arranged alphabetically is chosen for secondary suppression.
Field Name:	$Observed_{pd}$
Condition:	If the values of $Observed_{pd}$ that have been suppressed for a particular diagnosis group *d* are all equal to 1 then the smallest unsuppressed value of $Observed_{pd}$ for diagnosis group *d* is also suppressed with the special character *. If there is more than one provider *p* with the same value of $Observed_{pd}$ then the first provider when the provider codes are arranged alphabetically is chosen for secondary suppression.
Rationale:	This secondary suppression is applied to prevent the calculation of the suppressed value. For example, if the values of $Denominator_{pd}$ that have been suppressed for a particular provider *p* are all equal to 1 then it is possible to infer that the suppressed values are equal to 1 by subtracting the unsuppressed values of $Denominator_{pd}$ from $Denominator_{p}$, the total number of finished provider spells for provider, *p* and comparing this value to the count of suppressed values of $Denominator_{pd}$ for provider *p*.
Field Name:	$Denominator_{pd}$
Condition:	If only one value of $Denominator_{pd}$ has been suppressed for a particular provider *p* then the smallest unsuppressed value of $Denominator_{pd}$ for provider *p* is also suppressed with the special character *. If there is more than one diagnosis group *d* with the same value of $Denominator_{pd}$ then the value with the lowest diagnosis group number *d* is chosen for secondary suppression.
Field Name:	$Observed_{pd}$
Condition:	If only one value of $Observed_{pd}$ has been suppressed for a particular provider *p* then the smallest unsuppressed value of $Observed_{pd}$ for provider *p* is also suppressed with the special character *. If there is more than one diagnosis group *d* with the same value of $Observed_{pd}$ then the value with the lowest diagnosis group number *d* is chosen for secondary suppression.
Field Name:	$Denominator_{pd}$
Condition:	If only one value of $Denominator_{pd}$ has been suppressed for a particular diagnosis group *d* then the smallest unsuppressed value of $Denominator_{pd}$ for diagnosis group *d* is also suppressed with the special character *. If there is more than one provider *p* with the same value of $Denominator_{pd}$ then the first provider when the provider codes are arranged alphabetically is chosen for secondary suppression.
Field Name:	$Observed_{pd}$
Condition:	If only one value of $Observed_{pd}$ has been suppressed for a particular diagnosis group *d* then the smallest unsuppressed value of $Observed_{pd}$ for diagnosis group *d* is also suppressed with the special character *. If there is more than one provider *p* with the same value of $Observed_{pd}$ then the first provider when the provider codes are arranged alphabetically is chosen for secondary suppression.

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Rationale:	This secondary suppression is applied to prevent the calculation of the suppressed value by differencing. For example, if only one value of $Denominator_{pd}$ has been suppressed for a particular provider *p* then it is possible to calculate the suppressed value by subtracting the unsuppressed values of $Denominator_{pd}$ from $Denominator_{p}$, the total number of finished provider spells for provider *p*.

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7. Acknowledgements

We would like to thank the School of Health and Related Research (ScHARR) at the University of Sheffield for working with us to ensure that we have interpreted their final report appropriately.

We would like to thank Dr. Paul Aylin from the Dr. Foster Unit at Imperial College London for supplying the amended AHRQ CCS ICD-10 lookup table.

We would like to thank the members of the Technical Working Group of the HSMR Review for their expert guidance.

We would also like to thank our colleagues at the HSCIC for their help and advice in reviewing this specification document.

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Appendix A: CCS Diagnosis Groupings [9][10][11]

Category No.	CCS Category(s)	CCS Label(s)
1	1	Tuberculosis
2	2, 249	Septicaemia (except in labour), Shock
3	3	Bacterial infection; unspecified site
4	4	Mycoses
5	5	HIV infection
6	6, 7, 8, 9, 10	Hepatitis, Viral infection, Other infections; including parasitic, Sexually transmitted infections (not HIV or hepatitis), Immunizations and screening for infectious disease
7	11	Cancer of head and neck
8	12	Cancer of oesophagus
9	13	Cancer of stomach
10	14	Cancer of colon
11	15	Cancer of rectum and anus
12	16	Cancer of liver and intrahepatic bile duct
13	17	Cancer of pancreas
14	18	Cancer of other GI organs; peritoneum
15	19	Cancer of bronchus; lung
16	20	Cancer; other respiratory and intrathoracic
17	22, 23	Melanomas of skin, Other non-epithelial cancer of skin
18	24	Cancer of breast
19	25	Cancer of uterus
20	26, 28	Cancer of cervix, Cancer of other female genital organs
21	27	Cancer of ovary
22	29, 30, 31	Cancer of prostate, Cancer of testis, Cancer of other male genital organs
23	32	Cancer of bladder
24	33, 34	Cancer of kidney and renal pelvis, Cancer of other urinary organs
25	35	Cancer of brain and nervous system
26	37, 38	Hodgkin's disease, Non-Hodgkin's lymphoma
27	39	Leukemias
28	40	Multiple myeloma
29	41, 45	Cancer; other and unspecified primary, Maintenance chemotherapy; radiotherapy
30	42	Secondary malignancies
31	21, 36, 43	Cancer of bone and connective tissue, Cancer of thyroid, Malignant neoplasm without specification of site

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Category No.	CCS Category(s)	CCS Label(s)
32	44, 167	Neoplasms of unspecified nature or uncertain behavior, Nonmalignant breast conditions
33	46, 47	Benign neoplasm of uterus, Other and unspecified benign neoplasm
34	49	Diabetes mellitus without complication
35	50	Diabetes mellitus with complications
36	48, 51	Thyroid disorders, Other endocrine disorders
37	55	Fluid and electrolyte disorders
38	52, 53, 58	Nutritional deficiencies, Disorders of lipid metabolism, Other nutritional; endocrine; and metabolic disorders
39	59, 60	Deficiency and other anemia, Acute posthemorrhagic anemia
40	63	Diseases of white blood cells
41	57, 61, 62, 64	Immunity disorders, Sickle cell anemia, Coagulation and hemorrhagic disorders, Other hematologic conditions
42	65, 68	Mental retardation, Senility and organic mental disorders
43	66, 67, 69, 72	Alcohol-related mental disorders, Substance-related mental disorders, Affective disorders, Anxiety; somatoform; dissociative; and personality disorders
44	71	Other psychoses
45	70, 73, 74, 75	Schizophrenia and related disorders, Preadult disorders, Other mental conditions, Personal history of mental disorder
46	76, 77, 78	Meningitis (except that caused by tuberculosis or sexually transmitted disease), Encephalitis (except that caused by tuberculosis or sexually transmitted disease), Other CNS infection and poliomyelitis
47	79	Parkinson's disease
48	80, 81	Multiple sclerosis, Other hereditary and degenerative nervous system conditions
49	82, 113	Paralysis, Late effects of cerebrovascular disease
50	83	Epilepsy; convulsions
51	85	Coma; stupor; and brain damage
52	84, 86, 87, 88, 89, 90, 91, 92, 93, 94	Headache; including migraine, Cataract, Retinal detachments; defects; vascular occlusion; and retinopathy, Glaucoma, Blindness and vision defects, Inflammation; infection of eye (except that caused by tuberculosis or sexually transmitted disease), Other eye disorders, Otitis media and related conditions, Conditions associated with dizziness or vertigo, Other ear and sense organ disorders
53	95	Other nervous system disorders
54	96	Heart valve disorders
55	97	Peri-; endo-; and myocarditis; cardiomyopathy (except that caused by tuberculosis or sexually transmitted disease)
56	98, 99	Essential hypertension, Hypertension with complications and secondary hypertension

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Category No.	CCS Category(s)	CCS Label(s)
57	100	Acute myocardial infarction
58	101	Coronary atherosclerosis and other heart disease
59	102	Nonspecific chest pain
60	103	Pulmonary heart disease
61	104	Other and ill-defined heart disease
62	105	Conduction disorders
63	106	Cardiac dysrhythmias
64	107	Cardiac arrest and ventricular fibrillation
65	108	Congestive heart failure; nonhypertensive
66	109	Acute cerebrovascular disease
67	110, 111, 112	Occlusion or stenosis of precerebral arteries, Other and ill-defined cerebrovascular disease, Transient cerebral ischemia
68	114	Peripheral and visceral atherosclerosis
69	115	Aortic; peripheral; and visceral artery aneurysms
70	116	Aortic and peripheral arterial embolism or thrombosis
71	117	Other circulatory disease
72	118, 119, 120, 121	Phlebitis; thrombophlebitis and thromboembolism, Varicose veins of lower extremity, Hemorrhoids, Other disease of veins and lymphatics
73	122	Pneumonia (except that caused by tuberculosis or sexually transmitted disease)
74	125	Acute bronchitis
75	127	Chronic obstructive pulmonary disease and bronchiectasis
76	128	Asthma
77	129	Aspiration pneumonitis; food/vomitus
78	130	Pleurisy; pneumothorax; pulmonary collapse
79	131	Respiratory failure; insufficiency; arrest (adult)
80	132	Lung disease due to external agents
81	56, 133	Cystic fibrosis, Other lower respiratory disease
82	123, 124, 126, 134, 136, 137	Influenza, Acute and chronic tonsillitis, Other upper respiratory infections, Other upper respiratory disease, Disorders of teeth and jaw, Diseases of mouth; excluding dental
83	135	Intestinal infection
84	138	Esophageal disorders
85	139	Gastroduodenal ulcer (except hemorrhage)
86	140, 141	Gastritis & duodenitis, Other disorders of stomach and duodenum
87	143	Abdominal hernia
88	144	Regional enteritis and ulcerative colitis
89	145	Intestinal obstruction without hernia

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Category No.	CCS Category(s)	CCS Label(s)
90	146, 147	Diverticulosis & diverticulitis, Anal and rectal conditions
91	142, 148	Appendicitis and other appendiceal conditions, Peritonitis and intestinal abscess
92	149	Biliary tract disease
93	150	Liver disease; alcohol-related
94	151	Other liver diseases
95	152	Pancreatic disorders (not diabetes)
96	153	Gastrointestinal hemorrhage
97	154	Noninfectious gastroenteritis
98	155	Other gastrointestinal disorders
99	157	Acute and unspecified renal failure
100	156, 158	Nephritis; nephrosis; renal sclerosis, Chronic renal failure
101	159	Urinary tract infections
102	160, 161, 162	Calculus of urinary tract, Other diseases of kidneys and ureters, Other diseases of bladder and urethra
103	163	Genitourinary symptoms and ill-defined conditions
104	164, 165, 166	Hyperplasia of prostate, Inflammatory conditions of male genital organs, Other male genital disorders
105	168, 169, 170, 171, 172, 173, 175	Inflammatory diseases of female pelvic organs, Endometriosis, Prolapse of female genital organs, Menstrual disorders, Ovarian cyst, Menopausal disorders, Other female genital disorders
106	174, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 218	Female infertility, Contraceptive & procreative management, Spontaneous abortion, Induced abortion, Prostabortion complications, Ectopic pregnancy, Other complications of pregnancy, Hemorrhage during pregnancy; abruption placenta; placenta previa, Hypertension complicating pregnancy; childbirth; or the puerperium, Early or threatened labor, Prolonged pregnancy, Diabetes or abnormal glucose tolerance complicating pregnancy; childbirth; or the puerperium, Malposition; malpresentation, Fetopelvic disproportion; obstruction, Previous C-section, Fetal distress and abnormal forces of labour, Polyhydramnios and other problems of amniotic cavity, Umbilical cord complication, OB-related trauma to perineum and vulva, Forceps delivery, Other complications of birth; puerperium affecting management of mother, Normal pregnancy and/or delivery, Livebirths
107	197	Skin and subcutaneous tissue infections
108	198, 199, 200	Other inflammatory condition of skin, Chronic ulcer of skin, Other skin disorders
109	201	Infective arthritis and osteomyelitis (except that caused by tuberculosis or sexually transmitted disease)
110	204	Other non-traumatic joint disorders

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Category No.	CCS Category(s)	CCS Label(s)
111	205, 206	Spondylosis; intervertebral disc disorders; other back problems, Osteoporosis
112	207	Pathological fracture
113	211	Other connective tissue disease
114	54, 202, 203, 208, 209, 210, 212	Gout and other crystal arthropathies, Rheumatoid arthritis and related disease, Osteoarthritis, Acquired foot deformities, Other acquired deformities, Systemic lupus erythematosus and connective tissue disorders, Other bone disease and musculoskeletal deformities
115	213	Cardiac & circulatory congenital anomalies
116	214, 215, 216, 217	Digestive congenital anomalies, Genitourinary congenital anomalies, Nervous system congenital anomalies, Other congenital anomalies
117	219	Short gestation; low birth weight; and fetal growth retardation
118	220, 221, 222, 223	Intrauterine hypoxia and birth asphyxia, Respiratory distress syndrome, Hemolytic jaundice and perinatal jaundice, Birth trauma
119	224	Other perinatal conditions
120	226	Fracture of neck of femur (hip)
121	229	Fracture of upper limb
122	230	Fracture of lower limb
123	225, 227, 228, 231, 232	Joint disorders and dislocations; trauma-related, Spinal cord injury, Skull and face fractures, Other fractures, Sprains and strains
124	233	Intracranial injury
125	234	Crushing injury or internal injury
126	235	Open wounds of head; neck; and trunk
127	236	Open wounds of extremities
128	237	Complication of device; implant; or graft
129	238	Complication of surgical procedures or medical care
130	239	Superficial injury; contusion
131	240	Burns
132	241, 242, 243	Poisoning by psychotropic agents, Poisoning by other medications and drugs, Poisoning by nonmedicinal substances
133	244	Other injuries & conditions due to external causes
134	245	Syncope
135	246	Fever of unknown origin
136	247, 248	Lymphadenitis, Gangrene
137	250	Nausea and vomiting
138	251	Abdominal pain
139	252	Malaise and fatigue

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Category No.	CCS Category(s)	CCS Label(s)
140	253, 254, 255, 256, 257, 258, 259, 260	Allergic reactions, Rehabilitation care; fitting of prostheses; and adjustment of devices, Administrative/social admission, Medical examination/evaluation, Other aftercare, Other screening for suspected conditions (not mental disorders or infectious disease), Residual codes; unclassified, E Codes: All (external causes of injury and poisoning)

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Appendix B: Category Levels

Appendix B.1 – Age

Category No.	Values
1	7000 – 7012
2	1 – 4
3	5 – 9
4	10 – 14
5	15 – 19
6	20 – 24
7	25 – 29
8	30 – 34
9	35 – 39
10	40 – 44
11	45 – 49
12	50 – 54
13	55 – 59
14	60 – 64
15	65 – 69
16	70 – 74
17	75 – 79
18	80 – 84
19	85 – 89
20	90 – 120
21	Missing

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Appendix B.2 – Charlson Comorbidity Index

Category No.	Values
1	0
2	1 – 5
3	> 5

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Appendix B.3 – Admission Method

Category No.	Category Description	Values
1	Elective	11, 12, 13
2	Unknown	99
3	Acute	21, 22, 23, 24, 25, 2A, 2B, 2C, 2D, 28, 31, 32, 81, 82, 83, 84, 89, 98

Note: The release of version 6.2 of the Commissioning Data Sets (CDS) introduced an updated set of admission method codes to be used from 1st April 2013 onwards. Admission method code 25 was introduced as part of this update and admission method code 28 was replaced with codes 2A, 2B, 2C, 2D. Historic data with admission method code 28 will continue to be categorised as 'Acute' admissions.

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Appendix B.4 – Sex

Category No.	Category Description	Values
1	Male	1
2	Female	2
3	Unknown	0, 9

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Appendix C: Exclusion List

Appendix C.1 – UK Specialist Hospitals [12]

No.	Name	Provider Code
1	Royal National Orthopaedic Hospital NHS Trust	RAN
2	Nuffield Orthopaedic Centre NHS Trust	RBF
3	The Robert Jones and Agnes Hunt Orthopaedic Hospital NHS Foundation Trust	RL1
4	The Royal Orthopaedic Hospital NHS Foundation Trust	RRJ
5	Royal Brompton and Harefield NHS Foundation Trust	RT3
6	Papworth Hospital NHS Foundation Trust	RGM
7	Liverpool Heart and Chest NHS Foundation Trust	RBQ
8	Sheffield Children's NHS Foundation Trust	RCU
9	Birmingham Children's Hospital NHS Foundation Trust	RQ3
10	Alder Hey Children's NHS Foundation Trust	RBS
11	Great Ormond Street Hospital for Children NHS Foundation Trust	RP4
12	The Clatterbridge Cancer Centre NHS Foundation Trust	REN
13	The Christie NHS Foundation Trust	RBV
14	The Royal Marsden NHS Foundation Trust	RPY
15	The Walton Centre NHS Foundation Trust	RET
16	Liverpool Women's NHS Foundation Trust	REP
17	Birmingham Women's NHS Foundation Trust	RLU
18	Queen Victoria Hospital NHS Foundation Trust	RPC
19	Moorfields Eye Hospital NHS Foundation Trust	RP6

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Appendix C.2 – Mental Health Trusts [13] and Community Hospitals

No.	Name	Provider Code
1	North East London NHS Foundation Trust	RAT
2	Dorset Healthcare University NHS Foundation Trust	RDY
3	Leeds and York Partnership NHS Foundation Trust	RGD
4	Somerset Partnership NHS Foundation Trust	RH5
5	Nottinghamshire Healthcare NHS Trust	RHA
6	Oxfordshire Learning Disability NHS Trust	RHX
7	Cornwall Partnership NHS Foundation Trust	RJ8
8	Calderstones Partnership NHS Foundation Trust	RJX
9	West London Mental Health NHS Trust	RKL
10	North Staffordshire Combined Healthcare NHS Trust	RLY
11	Norfolk and Suffolk NHS Foundation Trust	RMY
12	Tavistock and Portman NHS Foundation Trust	RNK
13	Cumbria Partnership NHS Foundation Trust	RNN
14	Oxford Health NHS Foundation Trust	RNU
15	Northamptonshire Healthcare NHS Foundation Trust	RP1
16	Lincolnshire Partnership NHS Foundation Trust	RP7
17	Oxleas NHS Foundation Trust	RPG
18	South West London and St George's Mental Health NHS Trust	RQY
19	North Essex Partnership NHS Foundation Trust	RRD
20	South Staffordshire and Shropshire Healthcare NHS Foundation Trust	RRE
21	Barnet, Enfield and Haringey Mental Health NHS Trust	RRP

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No.	Name	Provider Code
22	Cambridgeshire and Peterborough NHS Foundation Trust	RT1
23	Pennine Care NHS Foundation Trust	RT2
24	Leicestershire Partnership NHS Trust	RT5
25	Suffolk Mental Health Partnership NHS Trust	RT6
26	2gether NHS Foundation Trust	RTQ
27	5 Boroughs Partnership NHS Foundation Trust	RTV
28	Central and North West London NHS Foundation Trust	RV3
29	South London and Maudsley NHS Foundation Trust	RV5
30	Humber NHS Foundation Trust	RV9
31	Avon and Wiltshire Mental Health Partnership NHS Trust	RVN
32	Southern Health NHS Foundation Trust	RW1
33	Mersey Care NHS Trust	RW4
34	Lancashire Care NHS Foundation Trust	RW5
35	East London NHS Foundation Trust	RWK
36	South Essex Partnership University NHS Foundation Trust	RWN
37	Worcestershire Mental Health Partnership NHS Trust	RWQ
38	Hertfordshire Partnership NHS Foundation Trust	RWR
39	Devon Partnership NHS Trust	RWV
40	Berkshire Healthcare NHS Foundation Trust	RWX
41	Sussex Partnership NHS Foundation Trust	RX2
42	Tees, Esk and Wear Valleys NHS Foundation Trust	RX3
43	Northumberland, Tyne and Wear NHS Foundation Trust	RX4
44	Cheshire and Wirral Partnership NHS Foundation Trust	RXA

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No.	Name	Provider Code
45	Rotherham, Doncaster and South Humber NHS Foundation Trust	RXE
46	South West Yorkshire Partnership NHS Foundation Trust	RXG
47	Derbyshire Healthcare NHS Foundation Trust	RXM
48	Birmingham and Solihull Mental Health NHS Foundation Trust	RXT
49	Greater Manchester West Mental Health NHS Foundation Trust	RXV
50	Surrey and Borders Partnership NHS Foundation Trust	RXX
51	Kent and Medway NHS And Social Care Partnership Trust	RXY
52	Coventry and Warwickshire Partnership NHS Trust	RYG
53	Dudley and Walsall Mental Health Partnership NHS Trust	RYK
54	Cambridgeshire Community Services NHS Trust	RYV
55	Sussex Community NHS Trust	RDR
56	Norfolk Community Health and Care NHS Trust	RY3
57	Birmingham Community Healthcare NHS Trust	RYW
58	Solent NHS Trust	R1C
59	Liverpool Community Health NHS Trust	RY1
60	Hertfordshire Community NHS Trust	RY4
61	Lincolnshire Community Health Services NHS Trust	RY5
62	Derbyshire Community Health Services NHS Trust	RY8
63	Kent Community Health NHS Trust	RYY
64	Worcestershire Health and Care NHS Trust	R1A
65	Shropshire Community Health NHS Trust	R1D
66	Staffordshire and Stoke on Trent Partnership NHS Trust	R1E
67	Bridgewater Community Healthcare NHS Trust	RY2

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No.	Name	Provider Code
68	Leeds Community Healthcare NHS Trust	RY6
69	Wirral Community NHS Trust	RY7
70	Hounslow and Richmond Community Healthcare NHS Trust	RY9
71	Central London Community Healthcare NHS Trust	RYX
72	Torbay and Southern Devon Health and Care NHS Trust	R1G
73	Gloucestershire Care Services NHS Trust	R1J

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Appendix D: Charlson Comorbidity Index Calculation

Introduction

The Charlson Index was developed in 1987 based on 1-year mortality data from internal medicine patients admitted to a single New York Hospital and was initially validated within a cohort of breast cancer patients. The original index encompasses 17 medical conditions weighted 1–6 with total scores ranging from 0–37.

A revision to the Charlson Index was presented by Dr. Foster Intelligence (DFI) in their HSMR Methodology documentation [14] indicating the weights should be updated (e.g. HIV had the highest weight in the original index but its mortality has fallen greatly, particularly in hospitalised patients) and calibrated using English data due to differences in coding practice and hospital patient population characteristics.

A table containing the old and new weights of the Charlson Comorbidity Index can be referenced in Appendix D.1: Charlson Comorbidity Index conditions, ICD-10 codes, new and old weights.

Overview

The methodology detailed below is based on the recommendation presented by ScHARR as part of their commission by the Department of Health (DH) to finalise the SHMI model with reference to the methodology provided by DFI.

The derivation of the Charlson Comorbidity Index to be used for the calculation of the SHMI will be based on all the Hospital Episode Statistics (HES) secondary diagnosis fields (DIAG_2 to DIAG_20 inclusive) with no upper cap to the value. The lowest value for the Charlson Comorbidity Index will be 0. i.e. if the calculated Charlson Comorbidity Index value is less than 0, it will be assigned a value of 0.

If the primary diagnosis of the first episode in the spell starts with R (chapter XVIII in the ICD-10 classification - Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified) the index is calculated using the second episode. If the primary diagnosis in the second episode also starts with R then the first episode is used regardless of R code.

Additionally, if cancer and metastatic cancer are both present then the score for cancer is ignored.

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Methodology

This specification is based on information provided by the Dr Foster Unit at Imperial College London that described the methodology they use to score the Charlson Index.

The Charlson Comorbidity Index for each provider spell is calculated as the sum of the weights for each of the conditions (see table below) in all secondary diagnosis fields (DIAG_2 –DIAG_20).

Where the second episode of the provider spell is used to derive the primary diagnosis, the secondary diagnosis fields from the second episode are used to calculate the Charlson Comorbidity Index. Otherwise, the secondary diagnosis fields from the first episode of the provider spell are used.

For every Charlson Comorbidity Index condition *i*, if any secondary diagnosis fields (DIAG_2 – DIAG_20 inclusive) contains any of the ICD-10 codes for condition *i*

then $weight_i = Newweight$
else $weight_i = 0$

The Charlson Comorbidity Index is calculated as $CCI = \sum_{i=1}^{17} weight_i$

There is an additional rule to remove the weight for cancer if both cancer and metastatic cancer are present.

If any secondary diagnosis fields (DIAG_2 – DIAG_20 inclusive) contains any of the ICD-10 codes for condition 15
then
If any secondary diagnosis fields (DIAG_2 – DIAG_20 inclusive) contains any of the ICD-10 codes for condition 11, set $CCI = CCI - 8$.

The following rule sets any negative values for the Charlson Comorbidity Index to be equal to zero.
If $CCI < 0$ then set $CCI = 0$.

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Appendix D.1: Charlson Comorbidity Index conditions, ICD-10 codes, new and old weights

Condition	Condition Name	ICD-10 codes	New weight	Old weight
1	Acute myocardial infarction	I21, I22, I23, I252, I258	5	1
2	Cerebral vascular accident	G450, G451, G452, G454, G458, G459, G46, I60-I69	11	1
3	Congestive heart failure	I50	13	1
4	Connective tissue disorder	M05, M060, M063, M069, M32, M332, M34, M353	4	1
5	Dementia	F00, F01, F02, F03, F051	14	1
6	Diabetes	E101, E105, E106, E108, E109, E111, E115, E116, E118, E119, E131, E136, E138, E139, E141, E145, E146, E148, E149	3	1
7	Liver disease	K702, K703, K717, K73, K74	8	1
8	Peptic ulcer	K25, K26, K27, K28	9	1
9	Peripheral vascular disease	I71, I739, I790, R02, Z958, Z959	6	1
10	Pulmonary disease	J40-J47, J60-J67	4	1
11	Cancer	C00-C76, C81-C97	8	2
12	Diabetes complications	E102, E103, E104, E107, E112, E113, E114, E117, E132, E133, E134, E137, E142, E143, E144, E147	-1	2
13	Paraplegia	G041, G81, G820, G821, G822	1	2
14	Renal disease	I12, I13, N01, N03, N052-N056, N072-N074, N18, N19, N25	10	2
15	Metastatic cancer	C77, C78, C79, C80	14	3
16	Severe liver disease	K721, K729, K766, K767	18	3
17	HIV	B20, B21, B22, B23, B24, O987	2	6

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References

[1] Details of the SHMI Publication Calendar can be referenced at http://www.hscic.gov.uk/SHMI

[2] Details of provider spelling can be referenced at http://www.hscic.gov.uk/SHMI

[3] Details of the ONS linked Date of Death to HES data can be referenced at http://www.hscic.gov.uk/SHMI

[4] Details of the World Health Organisation (WHO) International Classification of Diseases (ICD) can be found at http://www.who.int/classifications/icd/en/

[5] The lookup table mapping ICD-10 codes into CCS categories can be referenced at http://www.hscic.gov.uk/SHMI

[6] Spiegelhalter D J (2005) Funnel plots for comparing institutional performance. Statistics in Medicine, Apr 24(8): 1185-1202

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[8] Daly L (1992) Simple SAS macros for the calculation of exact binomial and Poisson Confidence limits. Computers in Biology and Medicine, Sept 22(5):351-361

[9] A definition and details of the diagnosis fields can be referenced at http://www.hscic.gov.uk/hesdatadictionary

[10] Any cleaning rules related to the diagnosis fields can be referenced at http://www.hscic.gov.uk/article/1825/The-processing-cycle-and-HES-data-quality

[11] The mapping from ICD-10 codes to CCS groups is produced by the Agency for Healthcare Research and Quality (AHRQ) and is can be referenced at http://www.hscic.gov.uk/SHMI

[12] List provided by Care Quality Commission (CQC), June 2011

[13] List of all Mental Health trusts available from http://www.nhs.uk/ServiceDirectories/Pages/MentalHealthTrustListing.aspx

[14] Details of the Charlson methodology used can be referenced at http://www.drfosterhealth.co.uk/hospital-guide/methodology/

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