The Royal Wolverhampton NHS Trust

Trust Board Report

Meeting Date:	27 March 2017
Title:	Mortality Update Report
Executive Summary:	The report presents the latest available information about the Trust's mortality rates, standardised and unadjusted together with analysis explaining potential causes for the higher than expected estimated standardised mortality rates observed. The Trust's mortality rates and activity are analysed in relation to the national and regional picture. A summary of the activity overseen by the Trust's Mortality Review Group (MRG) is presented in relation to monitoring of standardised mortality rates, coordinating audits into alerting diagnosis groups and overseeing the implementation of the directorate mortality review policy. A summary of results from directorate case note reviews for the current financial year is included. The report concludes that there is no evidence that the higher than expected estimated SMRs are related to the quality of care in the hospital. Evidence points to changes in data for RWT that may have led to the higher SMRs. The variation in the Trust's data when compared to the national activity is most notable post the implementation of the new Emergency Department (ED) model. Several actions the Trust is undertaking to provide evidence of data variation and assurance in relation to clinical care are detailed in section 4. The summary section provides a brief overview of each indicator detailed in the report, current position and explanation of status.
Action Requested:	1. To receive for update and assurance regarding elevated mortality statistics 2. To note the standardised mortality rates for RWT and potential causes together with actions to further investigate variation. 3. To note the action plan designed to provide further information in relation to causes for the raised SMRs and assurance in relation to clinical care.
Report of:	Medical Director
Author: **Contact Details:**	Corporate Clinical Informatics Analyst Tel 01902 307999
Links to Trust Strategic Objectives	

Resource Implications:	Revenue: Capital: Workforce: Funding Source: To be confirmed
Equality and Diversity Assessment	
Risks: BAF/ TRR **(describe risk and current risk score)**	
Public or Private: **(with reasons if private)**	Public
References: **(eg from/to other committees)**	
Appendices/ **References/** **Background Reading**	*Appendix b: Hogan et al. 2015, Avoidability of hospital deaths and association with hospital-wide mortality ratios: retrospective case record review and regression analysis BMJ.* 351:h3239 doi: 10.1136/bmj.h3239 Summary Hospital-level Mortality Indicator (SHMI) – full methodology and publications: https://indicators.hscic.gov.uk/webview/ Consultant outcomes http://www.nhs.uk/
NHS Constitution: **(How it impacts on any decision-making)**	In determining this matter, the Board should have regard to the Core principles contained in the Constitution of: - Equality of treatment and access to services - High standards of excellence and professionalism - Service user preferences - Cross community working - Best Value - Accountability through local influence and scrutiny

Contents

1. Summary

A recent research study conducted in England has confirmed that there was no significant association between hospital-wide SMRs and avoidable deaths (Hogan et al., 2015). An important failing of the SMRs is that the calculations are unable to account for variability in data and coding practices between hospitals, assuming practice is standardised, which is far from reality. Therefore, whilst the SMRs can indicate variation in the hospital's administrative data when compared with the rest of England, they should not be interpreted as being associated with quality of care or avoidable mortality. The retrospective case notes review is a more robust method of identifying hospital avoidable mortality. Whilst this is a useful measure to understand the hospital's provision of care, there are shortcomings in using this methodology to compare outcomes for different hospitals due to lack of standardisation currently.

Looking at the information available so far derived from diagnosis driven audits and directorate mortality reviews on a significant sample of deaths at the Trust, SUIs and senior clinicians' opinion there is no evidence that there is an association between clinical care provided in this hospital and the estimated higher than expected SMRs suggested by statistics.

Summary Hospital-level Mortality Indicator (SHMI) – the report presents the current position and estimates. The published SHMI is within expected limits for RWT whilst the estimated SHMI is higher than expected. Our investigations so far show two main reasons behind this increase. One is the denominator used for the calculation of statistics for our Trust, less ordinary admissions as a proportion of all admissions when compared with regional and national trusts; more pronounced decreased from 2015-16 coinciding with the raised SHMI. The other is the difference in coding for particular low risk diagnoses when compared to other trusts, leading to alerts for some diagnosis groups and a higher proportion of signs and symptoms diagnoses on admission from 2015-16.

Hospital Standardised Mortality Ratio (HSMR) – estimated measures are presented. The crude mortality rate for the HSMR basket of diagnosis for RWT has been consistently lower than the England average; therefore the higher HSMR does not reflect an increase in mortality rate. It is the lower expected death rate, a statistical measure that accounts for the higher HSMR. There are two main factors driving the higher than expected HSMR for RWT. One is the palliative care rate which is lower than the national average due to the fact that the Trust has been strictly coding for palliative care according to the clinical coding rules, which exclude an important proportion of palliative end of life care from the dataset. The HSMR uses palliative care coding in the risk adjustment model; for this Trust the palliative care adjustment accounts for up to 7 points of the higher HSMR. The HSMR is calculated based on a very small subset of Trust's data and the expected death rate is derived from up to 15% of emergency admissions. Moreover the reduction in overall Pneumonia admissions contributes to the higher than expected HSMR for this diagnosis group which contributes significantly to the overall HSMR. The variation in coding for kidney disorders is also a factor affecting the diagnosis level HSMR.

Directorate led mortality reviews – the Trust has implemented a mortality review policy which sets out a standardised system for reviewing all deaths occurring in the hospital. The Mortality Review Group (MRG) oversees the implementation of the policy and the learning from the retrospective case note reviews. The reviews undertaken from April 2016 have not identified failings in care that would have led to avoidable deaths (deaths that would not occur had the care provided been different). A small number of cases have been referred for further multidisciplinary review and the outcomes of these are to be presented at the MRG.

The Royal College of Physicians has worked on developing a national methodology for retrospective case notes reviews to be used by hospitals in order to enable comparison of avoidable death rates between hospitals. RWT is an early adopter, part of 40 Trusts in England to trial the new methodology in the coming financial year.

Diagnosis led mortality reviews – Every diagnosis group with an elevated SMR undergoes a coding and clinical review led by a consultant specialist in the area in question. Several audits have been completed in the past year with results confirming that clinical care provided was of good standards. Recommendations for learning were also made.

Consultant outcomes – The published consultants' outcomes in England have shown that mortality rates for RWT for selected specialties and procedures are either in line with the national average or better. These measures are more robust than the SHMI and HSMR as the risk adjustment is based on specific clinical information, the outcomes being compared for patients with similar conditions and taking into account risk factors in accordance to the case mix. The report summarising the outcomes for RWT has been published at the beginning of the financial year; specific outcomes can be accessed through the NHS Choices website.

Section 4 details the actions being undertaken by the Trust in order to explain and evidence the variation in data that underline the raised SMRs and provide assurance in relation to the clinical care provided to patients.

2. Mortality Statistics

The standardised mortality rates (SMRs) are calculated based on a case mix adjustment informed by the characteristics recorded at admission to hospital (demographics, main diagnosis, comorbidities, month of admission, palliative care etc.). The rates are very sensitive to data quality and what is recorded and coded for the admission episode. Each acute hospital's outcomes are compared with outcomes of the acute trusts in England for the same time period and for similar case mix.

The SMR is a rate calculated from the actual number of deaths divided by the expected number of deaths expressed as a percentage. The expected number of deaths is calculated by adding the cumulative risk of dying during that admission for all admissions for the period in question. This is calculated looking at case mix and comparing the outcomes with England's outcomes for similar characteristics. Important factors in the calculation of the risk of dying during the admission are primary diagnosis on admission, comorbidities, age, palliative care coding (full list is detailed in the technical documents for each methodology). Both Summary Hospital-level Mortality Indicator (SHMI) and the Hospital Standardised Mortality Ratio (HSMR) are based on ordinary admissions only; all day cases and regular attenders are excluded from the risk calculations.

The estimated SHMI and the estimated HSMR for RWT show higher than expected mortality at 95% and 99.8% confidence limits (CL).

More details including main differences between the two measures are included in Appendix a.

2.1. SHMI

The SHMI published by the HSCIC is within expected limits for the latest reported period and it has been increasing at decimal point, above the national benchmark from January to December 2015 onwards (Figure 1).

The differences between the estimated and published SHMI consist of different methodology for establishing outliers (the published methodology allows for wider variation) and the completeness of data at the time the published calculations are undertaken.

2.1.1. SHMI public statistics

The published SHMI for RWT is 1.1 for the period July 15 - June 16, an increase of 0.04 from the previous publication, and banded "as expected" (the benchmark is 1). Historically, the published SHMI has been lower than the national benchmark up to and including March 2015. From July 2014 to September 2015, the published SHMI was equal to the national benchmark and from the January 2015 to December 2015 publication period the value has crossed over the 1 value (national benchmark) increasing by 0.02 and 0.04 respectively for each subsequent publication period. The latest published SHMI for RWT for July 15 - June 16 was 1.099 (an increase of 0.04 comparing to the previous publication) and banded "as expected". The crude mortality for the SHMI basket was 3.6%, unchanged from the previous reporting period. The crude mortality rate for RWT is higher than England's 3.2% for this period for the SHMI basket.

Figure 1: SHMI and crude mortality rate published in England, by reporting period

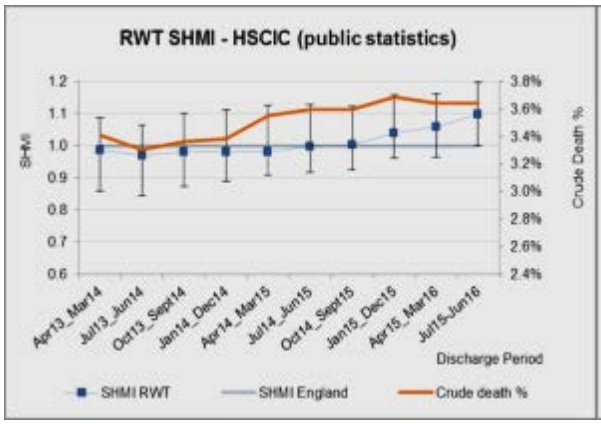
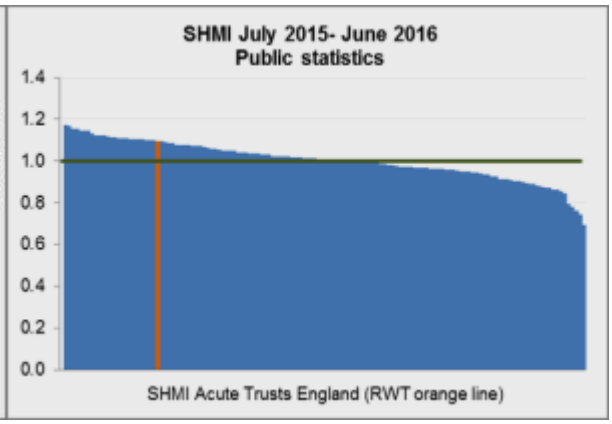


Figure 2: RWT's SHMI in the national context for the latest publication



2.1.2. SHMI – estimate provided by HED

The latest estimated SHMI for November 2015 – October 2016 is 110.5 and considered higher than expected at 95% and 99.8% CL (the benchmark is 100). This is slightly lower than the value for the previous 12 months period (111 for October 2015 – September 2016). Figure 3 shows RWT's current estimated SHMI in the national context. RWT and 31 (4 of which are our regional peers) other acute trusts have a SHMI banded as higher than expected.

The estimated SHMI for RWT has been showing higher than expected values from 2015-16 onwards, when it became significantly high at the 95% CL (figure 4). Figure 5 shows the SHMI for RWT well within expected limits for 2014-15. The increase in SHMI is more pronounced from quarter 3 of 2015-16 (figure 6).

Figure 3: Estimated SHMI November 2015 – October 2016, RWT and acute trusts in England

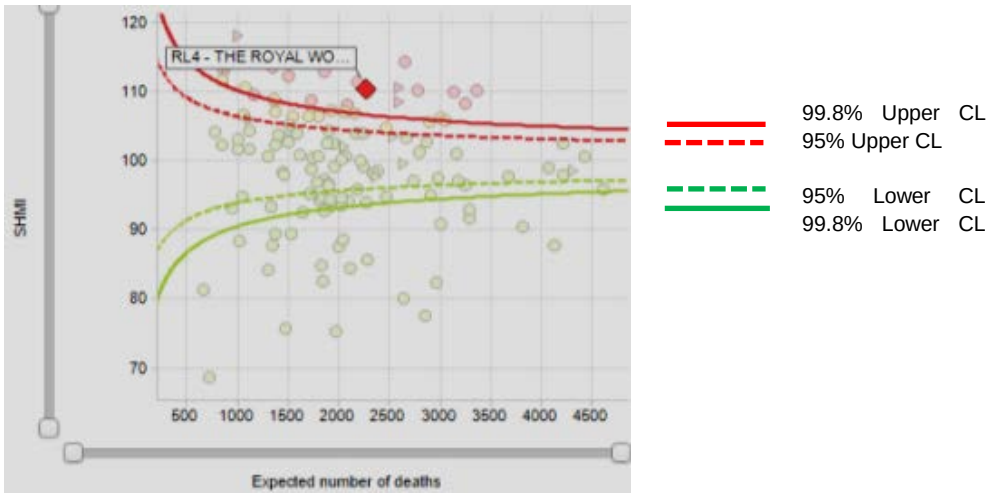


Figure 4: Estimated SHMI April 2015 – March 2016

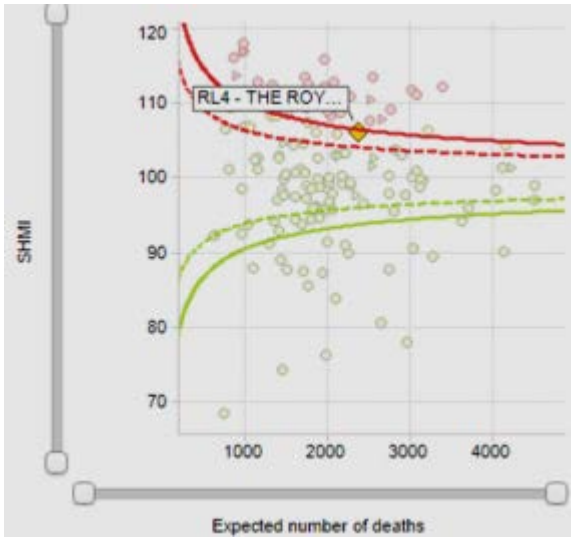


Figure 5: Estimated SHMI April 2014 – March 2015

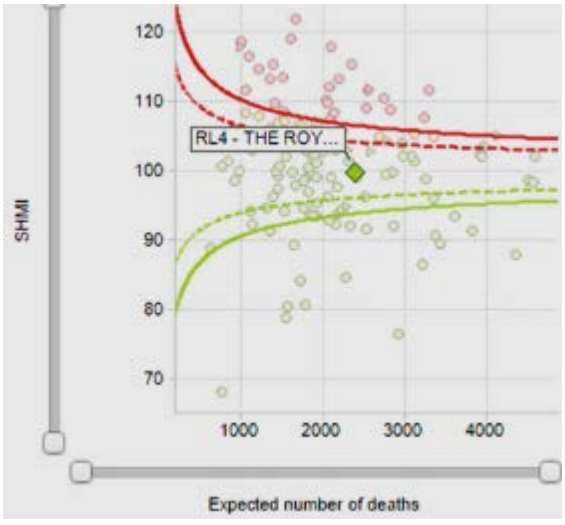
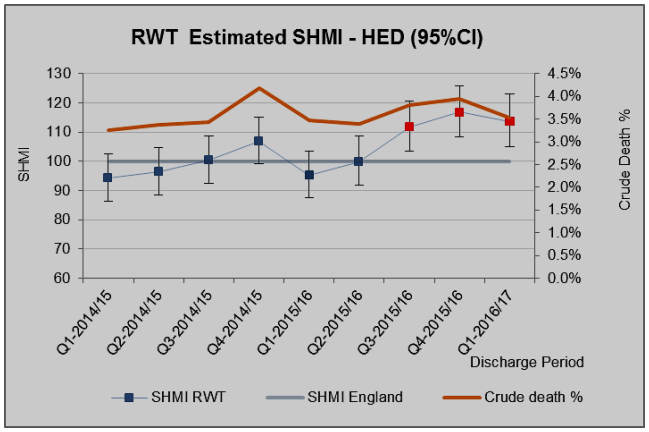


Figure 6: Estimated SHMI quarterly, RWT



An increasing number of diagnosis groups have shown a higher than expected estimated SHMI at 95% CL; these have been monitored through the MRG and audits were initiated for each of the alerting diagnosis group. Clinical audits undertaken so far did not uncover major failings in clinical care and coding audits performed led to corrections in primary diagnosis to a various degree (ranging from approximately 2% to over 40% correction rate for the audited sample for some diagnosis groups). Table 1 below shows the diagnosis groups with a higher than expected SHMI for the latest 12 months. The trust has shared findings from the acute bronchitis, pneumonia and fluid disorders audits with the CQC.

Overall in the past 18 months, in addition to the directorate level mortality reviews, 12 diagnosis specific audits have been completed, including 337 cases where patients died in hospital or within 30 days of discharge. In 88% of these cases care was found to be of very good standard and in the remaining cases some recommendations were made where elements of care could be improved. There were no cases identified within this sample where death may have been avoidable had care provided been different. Two cases have been referred for further multidisciplinary review and the outcomes will be presented at MRG. Three other clinical audits are in progress.

Table 1: Estimated SHMI – diagnosis groups with higher than expected mortality at 95% CL, November 2015 – October 2016.

Diagnosis group of admission	SHMI	95% LCL	95% UCL	No. deaths up to 30 days post discharge	No. deaths in hospital	No. discharges	% deaths in hospital	Crude mortality %	Alert status
Other ear and sense organ disorders	1314.4	147.6	4745.5	2	1	93	50%	2.2%	new alert
Other and ill-defined cerebrovascular disease	1130.6	227.2	3303.4	3	1	15	33%	20.0%	new alert
Short gestation; low birth weight; and fetal growth retardation	280.1	179.4	416.8	24	22	458	92%	5.2%	reviewed within directorate
Diabetes mellitus with complications	255.2	139.4	428.2	14	11	188	79%	7.5%	new alert
Fracture of upper limb	228.3	113.8	408.5	11	7	451	64%	2.4%	new alert
Other nutritional; endocrine; and metabolic disorders	207.1	122.7	327.3	18	13	208	72%	8.7%	new alert
Fluid and electrolyte disorders	199.6	159.7	246.6	86	57	452	66%	19.0%	audit completed
Spondylosis; intervertebral disc disorders; other back problems	194.0	108.5	320.0	15	11	659	73%	2.3%	new alert
Coma; stupor; and brain damage	189.3	100.7	323.7	13	13	34	100%	38.2%	new alert, audit completed last year
Epilepsy; convulsions	172.3	103.7	269.0	19	12	574	63%	3.3%	new alert
Senility and organic mental disorders	146.0	108.3	192.5	50	34	294	68%	17.0%	new alert, audit completed last year
Intestinal infection	144.8	101.9	199.6	37	27	992	73%	3.7%	audit in progress
Acute myocardial infarction	137.7	112.7	166.5	106	96	1266	91%	8.4%	audit completed
Acute bronchitis	130.0	100.7	165.0	67	50	1645	75%	4.1%	audit completed
Pneumonia (except that caused by tuberculosis or sexually transmitted disease)	128.2	114.6	143.0	321	284	1271	88%	25.3%	audit completed

Pneumonia is a main contributor to the increased SHMI and the audit highlighted that the likely cause of the alert could be the admission avoidance program; therefore a denominator effect rather than increased mortality as shown in the chart below (figure 6.1).

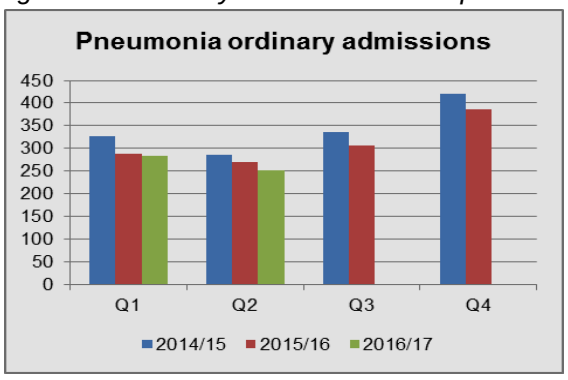
The number of pneumonia admissions as a proportion of all admissions has decreased in 2015-16 and 2016-17. The comparison shows a higher proportion of pneumonia admissions in England which impacts on RWT's standardised mortality rates (table 2). A coding validation for this diagnosis group over 8 months resulted in 8.5% cases having the primary diagnosis amended.

Table 2: Comparison England and RWT discharges where diagnosis on admission was pneumonia

	England			RWT		
	% Pneumonia admissions of all admissions	% Pneumonia deaths of all deaths	Pneumonia crude mortality	% Pneumonia admissions of all admissions	% Pneumonia deaths of all deaths	Pneumonia crude mortality
2014-15	2.7%	16.6%	20.6%	2.1%	13.5%	22.9%
2015-16	2.8%	16.3%	19.0%	1.9%	13.4%	25.9%
2016-17 Q1	2.9%	16.3%	17.8%	1.7%	11.4%	23.6%

**all activity based on ordinary admissions only*

Figure 6.1: Ordinary admissions where pneumonia was coded as diagnosis on admission



Analysis into activity profile at RWT compared with neighbouring trusts and England showed some differences that are likely to account at least to some extent for the raised SMRs. RWT has a smaller proportion of ordinary admissions compared to England (% ordinary admissions from all admissions). These are the admissions used for the calculation of SMRs. A drop of approximately 1% was observed in 2015-16 coinciding with the period when the SHMI increased. The crude death rate for RWT in 2015/16 has increased by 0.1% but the expected death rate has decreased by 0.1%. This is consistent with a denominator effect rather than higher mortality.

Another important element that affects the expected death rate is the proportion of admissions where the diagnosis coded on admission is from the "signs and symptoms" (S&S) group (low risk diagnoses that do not contribute to the overall expected death rate). In 2015-16 RWT had 1% more admissions where the diagnosis on admission was from the S&S group compared with the national average.

RWT consistently has a higher rate of in-hospital mortality compared to England and it has had consistently the highest or second highest rate in the region as well (table 3). This means of the total number of deaths occurring either in hospital or within 30 days of discharge, a higher proportion of deaths occurs in hospital rather than in the community for RWT.

For some diagnosis groups we have observed variation in coding of primary diagnosis when compared with England, which will also contributes to the alerting status. Whilst for some diagnoses corrections were made to coding, the reasons underlying the variation are not fully

understood and a larger audit would be needed to explain the variation and where coding practice might be different.

Table 3: Activity comparison RWT and England

Fiscal Year	RWT % ordinary admissions **	England % ordinary admissions	RWT SHMI crude death %	England SHMI crude death %	RWT SHMI expected death %	England SHMI expected death %	RWT SHMI in-hospital crude death %	England SHMI in-hospital crude death %	RWT SHMI % deaths in hospital	England SHMI % deaths in hospital
2014/15	44.7%	53.8%	3.6%	3.3%	3.6%	3.3%	2.7%	2.4%	74.9%	71.4%
2015/16	43.8%	53.3%	3.7%	3.2%	3.5%	3.2%	2.8%	2.3%	75.4%	71.0%
2016/17*	43.0%	52.7%	3.4%	3.1%	3.2%	3.1%	2.4%	2.2%	72.4%	70.7%
*Apr-Nov 2016; SHMI data Apr-Oct 16.										
**as a proportion of all admissions										

Another important difference is that in 2015-16, RWT has seen an increase in admissions, including ordinary admissions, whilst in England fewer admissions were recorded for the same period. The same was true for number of deaths included in the SHMI basket, an increase for RWT and a decrease for England (table 4). This should be analysed in the context of the implementation of the new admissions pathway through ED from November 2015.

Table 4: Activity comparison RWT and England

FY	England ordinary admissions	RWT ordinary admissions	England SHMI deaths	RWT SHMI deaths
2014/15	8737399	66826	288099	2384
2015/16	8654377	68655	279313	2515

The charts below (figure 6.2) show the changes in number of ordinary admissions for the last 3 years. The number of ordinary admissions, specifically the emergency ones, has increased in 2015/16 and 2016/17 and whilst the numbers are seeing a descending trend from Q1 of 2016-17, we still see more admissions than for the same time in previous years. Despite the increase in number of ordinary admissions, the proportion of ordinary admissions from total admissions decreased in the last 2 years as shown in table 3. The number of ordinary admissions forms the denominator in the calculations of mortality statistics.

Figure 6.2: Ordinary admissions trends for RWT (exclude day cases and regular attenders)

The overall crude mortality for RWT has been consistent, equal to or lower than England's and the regional Trusts'. It is the mortality rate for ordinary admissions only that is higher than the national rate (table 5). This should be looked at in the context of activity profile (table 6 and figure 7), which shows RWT to have the lowest proportion of ordinary admissions both compared to England and the regional trusts. RWT has seen a 1% drop in proportion of ordinary admissions whilst for England and regional trusts there is almost no variation year on year. RWT has the highest proportion of regular day attenders when compared to England and regional trusts. This suggests that the way activity is recorded at our trust is different and should be explored further.

Table 5: Crude mortality rates comparison RWT, regional trusts and England

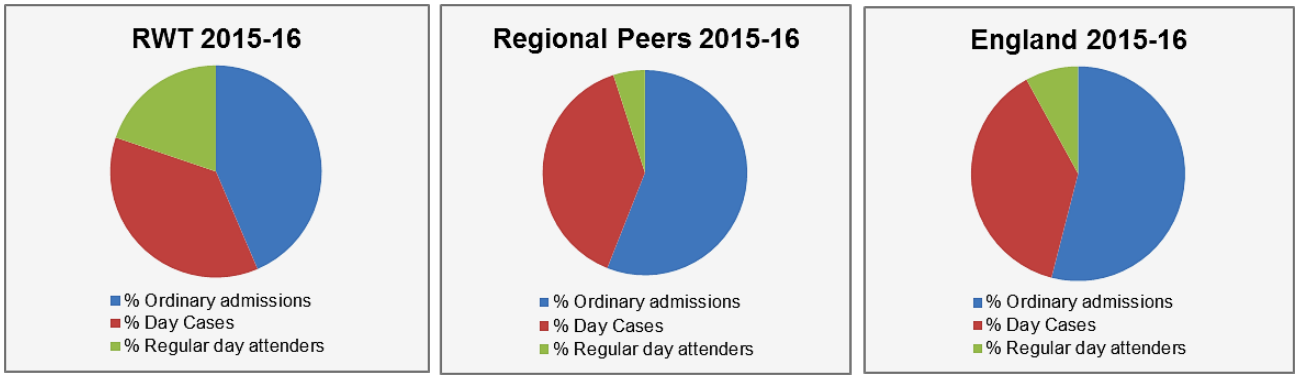
		2013-14		2014-15		2015-16	
		All admissions	Ordinary admissions only	All admissions	Ordinary admissions only	All admissions	Ordinary admissions only
% Mortality (excl. still births)	RWT	**1.20%**	**2.60%**	**1.20%**	**2.70%**	**1.20%**	**2.80%**
	Regional trusts*	1.40%	2.50%	1.40%	2.60%	1.40%	2.50%
	England	1.20%	2.30%	1.30%	2.40%	1.20%	2.30%
% Still births	RWT	**0.02%**	**0.04%**	**0.02%**	**0.04%**	**0.01%**	**0.03%**
	Regional trusts	0.02%	0.02%	0.01%	0.02%	0.01%	0.02%
	England	0.01%	0.02%	0.01%	0.02%	0.01%	0.02%

Table 6: Comparison of % admissions by patient classification as a % of total admissions

		2013-14	2014-15	2015-16	2016-17*
% Ordinary admissions	RWT	**44%**	**45%**	**44%**	**43%**
	England	54%	54%	54%	53%
	Regional trusts	56%	56%	56%	56%
% Day Cases	RWT	**33%**	**35%**	**37%**	**37%**
	England	37%	37%	38%	38%
	Regional trusts	38%	39%	39%	40%
% Regular day attenders	RWT	**22%**	**21%**	**20%**	**19%**
	England	9%	9%	8%	8%
	Regional trusts	6%	5%	5%	4%

Regional trusts excluding RWT; *Apr-Aug 16

Figure 7: Comparison of % admissions by patient classification as a % of total admissions for 2015-16



In the regional context, RWT has the 4th highest SHMI for November 2015 to October 2016 period and 6th highest for 2015-16. In 2014-15 RWT had the 2nd lowest SHMI in the region, after Sandwell. Overall, the SHMI for the regional trusts is also higher than expected for the latest reporting period.

Table 7: SHMI comparison RWT and regional trusts

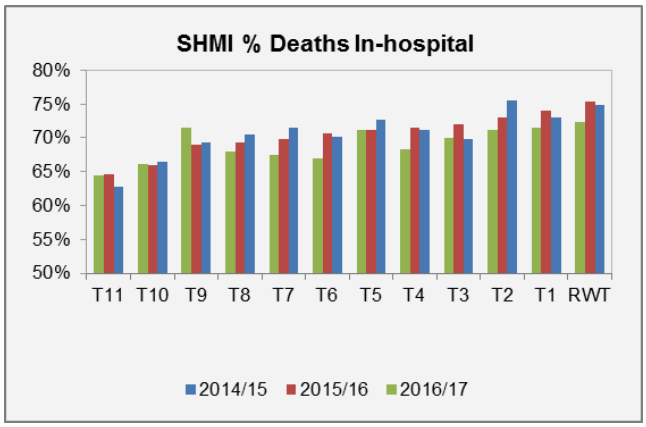
		Regional Trust											
FY	Measure	T1	T2	T3	T4	**RWT**	T5	T6	T7	T8	T9	T10	T11
2014/15	SHMI	109	104	105	104	**100**	118	105	103	103	112	95	100
	SHMI (in hospital)	108	102	102	106	**105**	113	104	108	106	103	96	88
	SHMI (out of hospital)	109	109	113	101	**86**	130	108	89	95	134	92	133
2015/16	SHMI	105	107	101	108	**106**	117	114	98	103	110	103	102
	SHMI (in hospital)	102	106	97	111	**114**	112	117	101	107	101	103	92
	SHMI (out of hospital)	110	110	113	101	**88**	130	106	90	92	134	103	126
2016/17	SHMI	99	105	95	109	**106**	112	109	97	101	104	97	96
	SHMI (in hospital)	93	99	90	107	**111**	112	108	98	102	97	97	87
	SHMI (out of hospital)	112	118	108	112	**97**	114	112	94	97	124	96	118

Red – SHMI significantly higher than expected; Green - SHMI significantly lower than expected; Black – values as expected.

Table 7 shows the SHMI comparison for the 3 financial years, including the SHMI calculated for in-hospital and out of hospital deaths.

RWT consistently has the lowest SHMI for out of hospital deaths, correlated with one of the highest rate of in-hospital mortality in the region and well above the national average (figure 8). This suggests that in the area serviced by RWT less patients are discharged to die in the community within 30 days when compared to neighbouring trusts and England overall. Moreover some patients who might not need an acute admission could be admitted to die in hospital due to lack of other provisions in the community.

Figure 8: Comparison % deaths occurring in hospital, SHMI basket



In relation to the expected mortality rates in the region, RWT sits approximately in the middle for both crude and expected mortality rates. The variation between expected mortality rates is to be noted (table 8).

Table 8: SHMI crude rates comparison RWT and regional trusts

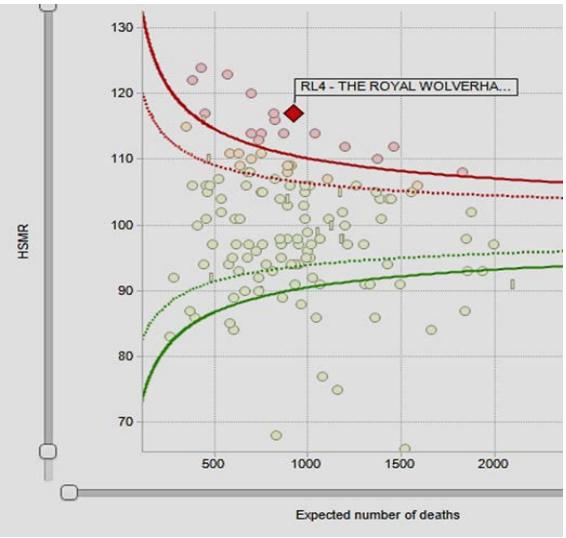
	2014/15		2015/16		2016/17	
Regional Trust	Crude mortality rate	Expected mortality %	Crude mortality rate	Expected mortality %	Crude mortality rate	Expected mortality %
T1	3.2%	3.1%	3.1%	2.8%	2.9%	2.6%
T2	3.0%	3.2%	3.1%	3.0%	2.8%	2.9%
T3	3.3%	3.2%	3.0%	3.0%	2.8%	2.9%
T4	3.8%	3.5%	3.4%	3.2%	3.3%	3.3%
T5	3.4%	3.3%	3.5%	3.4%	3.1%	3.3%
RWT	**3.6%**	**3.6%**	**3.7%**	**3.5%**	**3.4%**	**3.2%**
T6	4.0%	3.6%	3.9%	3.5%	3.9%	3.7%
T7	3.7%	3.5%	3.8%	3.5%	3.5%	3.4%
T8	4.1%	3.5%	4.1%	3.5%	4.2%	3.7%
T9	3.7%	3.7%	3.8%	3.8%	3.7%	3.9%
T10	4.2%	4.0%	4.1%	4.0%	4.0%	4.0%
T11	4.2%	4.0%	4.6%	4.0%	4.5%	4.1%

RWT's average comorbidity score per spell is one of the highest in the region whilst the proportion of admissions coded with palliative care is one of the lowest, the latter likely to be due to local interpretation of the use of the palliative care code in other trusts.

2.2. HSMR

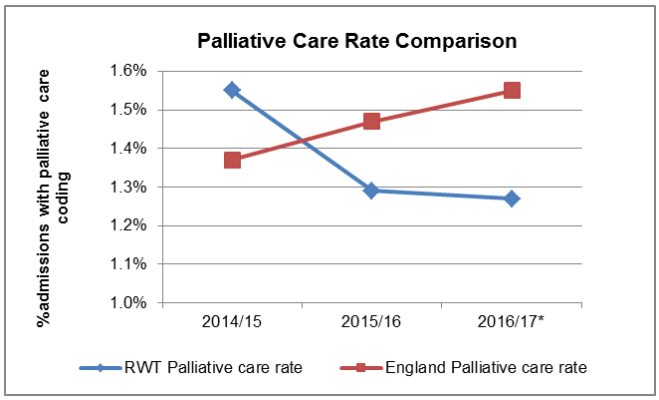
THE HSMR measure has been showing higher than expected mortality for RWT, increasing by 10 points in 2015/16 and 2016/17 up to November 2016. The estimated HSMR value for RWT for December 2015 to November 2016 is 116.7 and banded as higher than expected at 95% and 99.8% CL.

The chart below shows RWT's HSMR in the national context for the latest 12 months.



One of the main causes of this has been the decrease in proportion of admissions with palliative care coding at RWT at a time when the rate has increased in England (figure 9). Palliative care coding is a factor used in the risk adjustment for HSMR and the calculation has not been revised in the last years despite changes in the end of life care pathways, the ways hospitals deliver end of life care and the well-known misuse of the code across England. We cannot ascertain the correct use of the code strictly according to coding rules across England, and we are not aware of any audits undertaken by the HSCIC. Whilst previously RWT had a palliative care rate coding higher than the national average, justified by the service provision, following the introduction of the SWAN end of life care pathway this rate has decreased. This accounts for up to 7 points in the HSMR increase, see table 10, HSMR without adjusting for palliative care.

Figure 9: Palliative care coding rates comparison



The HSMR is an estimated measure that is no longer used formally in England and there is no oversight or validation for the calculations, therefore it should be interpreted with caution.

The reason for the increase in HSMR for RWT is not very well understood and it is likely to be a cumulative effect due to Trust's data showing variance from England average. In addition to the palliative care issue shown above, the denominator plays an important role in the calculation of the expected death rate. RWT has one of the lowest proportions of ordinary admissions in the region and in England. The HSMR is based on a subset of the ordinary admissions; a group of 56 diagnosis groups (coded on admission) thought to account for over 80% of in-hospital mortality. In 2015-16, 64.4% of RWT's ordinary admissions were included in the calculation of the HSMR. That means 64.4% out of 43.8% of total activity, therefore a low denominator for the calculation of the expected death rate. As shown in table 9, and figure 9.1, RWT's unadjusted death rate for the HSMR basket is equal or lower than England's, however the expected death rate does not follow the same patterns; RWT's expected death rate is much lower than England's with a significant drop since 2015/16. The conclusion from this is that the raised HSMR does not reflect an increase in mortality rates at RWT, on the contrary RWT has a lower mortality rate for this basket of diagnoses than England. It is the expected death rate that has substantially decreased leading to the raised HSMR.

Table 9: HSMR comparison RWT and England

Fiscal Year	RWT % ordinary admissions **	England % ordinary admissions	RWT % ordinary admissions included in HSMR	England % ordinary admissions included in HSMR	RWT HSMR crude death %	England HSMR crude death %	RWT HSMR expected death %	England HSMR expected death %
2014/15	44.7%	53.8%	61.0%	54.6%	3.9%	3.9%	3.6%	3.9%
2015/16	43.8%	53.3%	64.4%	55.9%	3.6%	3.7%	3.1%	3.7%
2016/17*	43.0%	52.7%	66.7%	56.7%	3.1%	3.4%	2.6%	3.4%
*Apr-Nov 2016								
**as a proportion of all admissions								

Figure 9.1: Observed and expected unadjusted mortality rates comparison, HSMR basket of diagnoses.

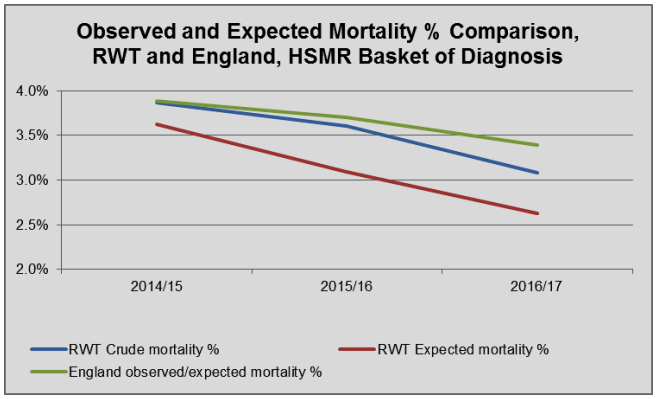


Table 10 below also shows the decrease in proportion of palliative care coded spells from 2015-16, and the higher average comorbidity score per spell for RWT when compared with England.

Table 10: RWT HSMR, comparison with England

Fiscal Year	No. discharges	No. deaths	Expected no. deaths	Crude mortality %	Expected mortality %	% deaths attributed through transfer	HSMR	HSMR 95% LCL	HSMR 95% UCL	HSMR (without adjusting for palliative care)	Palliative discharges %	Average comorbidities per spell	England observed/ expected mortality %	England average comorbidities per spell	England Palliative discharges %
2014/15	40303	1560	1460	3.9%	3.6%	4.1%	**106.8**	101.6	112.3	**105.6**	2.0%	6.31	3.9%	5.37	2.0%
2015/16	44208	1591	1366	3.6%	3.1%	3.3%	**116.5**	110.8	122.3	**110.7**	1.6%	6.48	3.7%	5.62	2.1%
2016/17	30567	940	804	3.1%	2.6%	1.6%	**116.9**	109.6	124.7	**109.2**	1.5%	6.84	3.4%	5.71	2.2%

The death rate has increased slightly in line with the increase in activity/ admissions. This was in the context of admissions numbers in England seeing a decrease in 2015-16. The expected death rate however has not increased in line with the increase in activity and number of deaths, which gives the higher SHMI and HSMR. The average comorbidity score per admission at RWT is higher than the national average, suggesting admissions with more serious comorbidities however the expected death rate does not reflect that.

An important factor for the HSMR increase is the palliative care rate. That is the proportion of cases that received face to face specialist palliative care input. Whilst the palliative care rate at RWT has decreased, the rate for England has increased (figure 9).

Table 11: RWT HSMR, activity captured by method of admission

		2014/15	2015/16	2016/17
Elective	Number of discharges	**19638**	**22480**	**16411**
	Expected number of deaths	24	21	13
	Number of deaths	28	26	11
	Expected mortality rate	0.1%	0.1%	0.1%
	Crude mortality rate	0.1%	0.1%	0.1%
Non-elective	Number of discharges	**20665**	**21728**	**14156**
	Expected number of deaths	1436	1345	791
	Number of deaths	1532	1565	929
	Expected mortality rate	6.9%	6.2%	5.6%
	Crude mortality rate	7.4%	7.2%	6.6%

Following on from the point above related to proportion of admissions used for the calculation of the HSMR, it is important to add the element of admission method in analysing the causes for elevated HSMR. The HSMR calculation was based on 64.4% of RWT's ordinary admissions in 2015-16. Table 11 shows the split for this activity between elective and emergency admissions. The figures show that the activity used for the calculation of the HSMR is split almost half way between electives and non-electives with number of emergency discharges decreasing from 2015/16 with slightly more elective admissions. The expected mortality rate for the elective admissions is negligible at 0.1% compared with the emergency admissions expected death rate at over 6%. This in effect means that the expected death rate for the HSMR measure is calculated using a very small subset of the Trust's activity, 32% of all ordinary admissions in 2015/16 (ordinary admissions representing 44% of trust's activity for this year).

This strongly suggests that any variation in coding practice from the national average will stand out as an outlier. Equally any changes in denominator, even if small will affect the SMRs.

It is likely the deterioration in SMRs may be due to changes in data following the implementation of the new admissions model from November 2015 (the opening of the new A&E and implementation of "Physician A" model). To a lesser extent, changes in data following the transfer of the Staffordshire activity and the West Park admissions onto PAS may also contribute to the denominator effect. Audits undertaken together with data analysis support the hypothesis that changes in the ordinary admissions denominator used in the calculation of these measures contributes to the increase in SHMI and HSMR. The admission avoidance model means that admitted patients have a higher severity of disease associated with advanced age and are more likely to die whilst patients with good prognosis who can be treated ambulatory are not admitted,

therefore excluded from the denominator. Whilst this is a model that benefits the patients, it has a negative impact on indicators such as mortality statistics and potentially on income. This is mainly because not all hospitals practice this model and the mortality statistics are calculated by comparing one trust's outcomes with the rest of England.

3. Directorate Mortality Reviews

It is well known that the mortality statistics based on administrative date are not able to reflect quality of care, they show variation. Research in England particularly in 2015-2016, commissioned by the DoH and current policy direction in England, highlight the need for a qualitative approach in assessing mortality in hospitals and enabling improvements in practice with an aim to eliminate avoidable mortality. Hogan and colleagues, 2015, confirmed the lack of statistical significance in associating higher than expected SMRs with avoidable mortality.

The Trust has implemented a revised mortality review policy, drawing on evidence from research and in consultation with other trusts. During 2016, the MRG has coordinated work to ensure all directorates undertake the required audits in a consistent way and in compliance with the policy requirements. All deaths occurring in hospital must have an initial peer review conducted and if suboptimal care was identified further actions are recommended. This can be in a form of feedback to clinicians, directorate or trust wide recommendations for practice or escalation to a multidisciplinary review or a SUI. A basic electronic system has been set up to collate the information from mortality reviews and whilst the number of reviews uploaded on the system has improved considerably, more work needs to be done to ensure this happens in a timely manner to enable complete monthly reporting.

For April 2016 to January 2017 there were 1390 deaths occurring in hospital. The shared database records 67% of these having the initial review information uploaded. The actual proportion of reviews completed is likely to be higher; it is known that a delay can occur between undertaking the case note review and uploading the proforma on the repository. Table 12 below shows a summary of the initial reviews, with the NCEPOD grading allocated. Results from MDTs and SUIs are expected to be presented to the MRG shortly for the cases where this was indicated.

Table 12: Summary of directorate mortality initial reviews April 2016-January 2017

		NCEPOD Score												
No. Cases allocated for review	No. reviews uploaded	1	2	3	4	5	Pending MDT findings	Pending SUI	% Reviews returned	% Reviews graded 1	% Reviews graded 2	% Reviews graded 3	% Reviews graded 4	% Reviews graded 5
1390	933	845	60	17	10	1	24	8	67%	91%	6.4%	1.8%	1.1%	0.1%
Deceased April 2016 - January 2017; reviews uploaded to SharePoint on 21/02/2017														

Table 13: NCEPOD grades descriptions

NCEPOD Grading	Grade Description
1	Good practice
2	Room for improvement (Aspects of clinical care that could have been better)
3	Room for improvement (Aspects of organisational care that could have been better)
4	Room for improvement (Aspects of clinical and organisational care that could have been better)

5	Less than satisfactory (Several aspects of clinical and/or organisational care which were below acceptable standards)

4. Future Developments and Actions

The DoH has announced intention to require hospitals to publish the avoidable mortality rates from 2017. The paper acknowledged variability in terms of definitions and understanding of what was classed as an avoidable or preventable death across trusts in England. It is acknowledged that whilst most hospitals have implemented a system of reviewing deaths, there is variation in methodology used. Methodology and guidance are expected to be developed in order to provide a standardised approach for all trusts so that data can be comparable.

The Royal College of Physicians has been leading on the development of the National Mortality Case Record Review Programme, a standardised approach to mortality case record review for adult deaths in acute hospitals in England and Scotland. The methodology is essentially qualitative, aiming to address the bias and controversy associated with statistical measures for mortality rates. The program was piloted with 6 trusts and as part of the first phase of the national rollout a cohort of 30-40 hospitals were invited to adopt the new methodology for case note reviews. Our trust signed up to being an early adopter and our submission has been accepted. Currently further information is awaited after which the expectation is that the new program will be integrated within existing mortality, clinical governance and quality improvement work.

The Trust should undertake an impact assessment of the changes in admissions pathways in order to gain a better understanding of the extent to which the differences in activity profile are impacting on SMRs and income. At the same time further work should be undertaken to enable understanding the variances in coding practice for specific diagnosis groups. The recording of palliative care should also be revisited following consultation with similar trusts with a much higher rate of coded palliative admissions.

The issues related to the mortality rates for the Trust have been discussed in details at the Mortality Review Group, Mortality Review Assurance Group and Trust Management Committee. The actions below have been agreed in order to investigate further the variation in SMRs and also to provide assurance in relation to clinical care at RWT. The Trust's committees and the Board will receive updates in relation to progress and findings in due course.

4.1. Actions agreed

1.1.2. A senior external clinical review of clinical pathways within the organisation. This will be organised shortly, terms of reference are in process of being set out and will be overseen and approved by the executive mortality assurance group.

1.1.3. An external peer review of deceased patients' case notes, focused on a selection of diagnosis groups that have had a raised SMR and have been reviewed internally.

1.1.4. External review of data and clinical coding by an independent reviewing organisation with expertise and experience in managing data sets and clinical coding.

1.1.5. Engaging with CSU to draw on their expertise of working with other trusts on similar issues and explore potential causes for diagnosis level raised SMRs.
1.1.6. A review of palliative care and end of life care coding to include a review of practices in England in order to aid understanding of the wide variation across England.
1.1.7. Review and improve plan of consultants and clinical coders working together to improve accuracy of coding.
1.1.8. Escalation of the elevated SHMI and HSMR to the Trust's risk registers.
1.1.9. Update provided to the Trust Board for discussion.

5. Appendix a – Glossary

The formal mortality indicator in England is the Summary Hospital-level Mortality Indicator (SHMI), which is published bimonthly by the HSCIC. This indicator is calculated for 12 months period, reporting 6 months in arrears. Using the tools provided by the Healthcare Evaluation Data (HED), we can analyse a more up to date estimated SHMI, which is released monthly, 3 months in arrears.

The Hospital Standardised Mortality Ratio (HSMR) is a measure that was previously reported in England up to three years ago. Through the HED tools we have access to an estimated HSMR. To note, there is no formal validation in place for this indicator and it is not a publicly reported or scrutinised measure.

The SHMI is a more complete measure that includes the activity captured by the HSMR. The HSMR however only includes a subset of admissions and deaths as described below. In brief, the most important differences between the two indicators are as follows:

- SHMI includes all ordinary admissions (excluding day cases and regular attenders) and all deaths either as an inpatient or within 30 days of discharge
- HSMR includes only a subset of 56 diagnosis groups (based on diagnosis on the first episode of admission)
- HSMR includes only deaths as an inpatient and links admissions if patients are transferred from one hospital to another, attributing the death to each hospital regardless of where the death occurred.
- HSMR uses palliative care as a factor in the risk adjustment whilst the SHMI does not take into account this measure.
- The two measures use different statistical methodologies for establishing outliers. HSMR and estimated SHMI use 99.5% confidence limits (CL). The published SHMI uses an over dispersion model with 95% CL which allows greater variation, therefore whilst a trust can be presented as an outlier looking at the estimated measures the same trust could be presented as having a SHMI within expected limits using the published methodology.

Avoidability of hospital deaths and association with hospital-wide mortality ratios: retrospective case record review and regression analysis

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ABSTRACT

OBJECTIVES

To determine the proportion of avoidable deaths (due to acts of omission and commission) in acute hospital trusts in England and to determine the association with the trust's hospital-wide standardised mortality ratio assessed using the two commonly used methods - the hospital standardised mortality ratio (HSMR) and the summary hospital level mortality indicator (SHMI).

DESIGN

Retrospective case record review of deaths.

SETTING

34 English acute hospital trusts (10 in 2009 and 24 in 2012/13) randomly selected from across the spectrum of HSMR.

MAIN OUTCOME MEASURES

Avoidable death, defined as those with at least a 50% probability of avoidability in view of trained medical reviewers. Association of avoidable death proportion with the HSMR and the SHMI assessed using regression coefficients, to estimate the increase in avoidable death proportion for a one standard deviation increase in standardised mortality ratio.

PARTICIPANTS

100 randomly selected hospital deaths from each trust.

RESULTS

The proportion of avoidable deaths was 3.6% (95% confidence interval 3.0% to 4.3%). It was lower in 2012/13 (3.0%, 2.4% to 3.7%) than in 2009 (5.2%, 3.8% to 6.6%). This difference is subject to several factors, including reviewers' greater awareness in 2012/13 of orders not to resuscitate, patients being perceived as sicker on admission, minor differences in review form questions, and cultural changes that might have discouraged reviewers from criticising other clinicians. There was a small but statistically non-significant association between HSMR and the proportion of avoidable deaths (regression coefficient 0.3, 95% confidence interval −0.2 to 0.7). The regression coefficient was similar for both time periods (0.1 and 0.3). This implies that a difference in HSMR of between 105 and 115 would be associated with an increase of only 0.3% (95% confidence interval −0.2% to 0.7%) in the proportion of avoidable deaths. A similar weak non-significant association was observed for SHMI (regression coefficient 0.3, 95% confidence interval −0.3 to 1.0).

CONCLUSIONS

The small proportion of deaths judged to be avoidable means that any metric based on mortality is unlikely to reflect the quality of a hospital. The lack of association between the proportion of avoidable deaths and hospital-wide SMRs partly reflects methodological shortcomings in both metrics. Instead, reviews of individual deaths should focus on identifying ways of improving the quality of care, whereas the use of standardised mortality ratios should be restricted to assessing the quality of care for conditions with high case fatality for which good quality clinical data exist.

WHAT IS ALREADY KNOWN ON THIS TOPIC

Hospital-wide standardised mortality ratios (SMRs) are commonly used as an indicator of a hospital's quality but have not been validated

The proportion of hospital deaths judged to be avoidable based on retrospective case record review has been reported to be about 4-5%

The association between hospital-wide SMRs and the proportion of avoidable deaths is uncertain; one study found no association but was too small to provide definitive evidence

WHAT THIS STUDY ADDS

The lack of a statistically significant association between hospital-wide SMRs and the proportion of avoidable deaths was confirmed

Both hospital-wide SMRs and avoidable death proportions based on the judgment of only one or two reviewers have methodological shortcomings making them unsuitable indicators to compare the quality of hospitals

Introduction

For over 20 years the overall standardised mortality ratio (SMR) for all deaths in a hospital has been advocated as an indicator of the quality (encompassing both safety and effectiveness) of a hospital.[1] Although an association between the SMR for a specific disease (such as acute myocardial infarction, pneumonia, and severe sepsis) and measures of quality of care (such as adherence to clinical guidelines) has been shown,[2-5] similar studies on hospital-wide SMRs have not been reported. Despite concerns about the value of hospital-wide SMRs being raised by experts in the United Kingdom,[6] United States,[7] Canada,[8] and Australia,[9] many countries have adopted them and continue to use them.

The Keogh review[10] used hospital-wide SMRs to select acute hospital trusts (National Health Service organisations that comprise either a single hospital or a group of local hospitals) in England for detailed consideration of their quality.[10] This review was established in February 2013 in the wake of the second Francis report into Mid-Staffordshire NHS Foundation Trust.[11] It aimed "to review the quality of care and treatment provided by those NHS trusts and NHS foundation

trusts that are persistent outliers on mortality indicators [hospital-wide SMRs].” The 14 trusts selected had a higher than expected hospital-wide SMR for two consecutive years according to either of the two widely used metrics—the hospital standardised mortality ratio (HSMR) and the summary hospital level mortality indicator (SHMI).

In July 2013, one of the main recommendations of the review was the need for a study into the relation between “excess mortality rates” (based on hospital-wide SMRs) and “actual avoidable deaths” (based on retrospective case record review by experienced clinicians).[12] The latter was considered to provide a more meaningful indication of the quality of clinical care, being based on clinicians’ careful and detailed review of each death rather than on a statistical probability derived from routine administrative data. Although case record review should not be considered as the ideal, given its known limited reliability,[13] at least a moderately strong association between the two measures would provide some reassurance as to the validity of hospital-wide SMRs as a measure of mortality associated with poor quality of care.

The only published account of the relation between hospital-wide SMRs and proportions of avoidable deaths was a study of 10 acute hospital trusts in England in 2009.[14] This found no association with the HSMR (correlation coefficient –0.01).[15] Given the small sample size, however, the 95% confidence interval was wide (–0.64 to 0.62). Subsequently, data for SHMI were obtained,[16] which showed that the association with that metric was also not significant (–0.24, 95% confidence interval –0.76 to 0.46).

To meet the objective of the Keogh review, we enlarged that study to increase confidence in the estimate of the proportion of avoidable deaths determined by case record review and the association between the proportion of deaths that were avoidable (due to acts of omission and commission) in a trust and its HSMR and SHMI.

Methods

The retrospective case record review design that we used was an adaptation of studies conducted in the UK, Canada, and the Netherlands.[17-20]

Sampling strategy

A clinically important association between hospital-wide SMR and avoidable death proportion would be indicated by a regression coefficient of at least 0.5 (that is, an increase of 1% in avoidable death proportion for an increase in HSMR of one standard deviation, assumed to be 10). We report regression coefficients rather than correlation coefficients, for the reason explained below in the description of analyses.

We determined that, based on an avoidable death proportion of 5% (SD 2%),[6] a sample of 34 trusts and 100 cases per trust would have 80% power to detect a regression coefficient of 1.4 (that is, a 1.4 percentage point increase in avoidable death proportion for a 10 point increase in SMR). Estimates of statistical power were based on simulated two stage sampling of 34 trusts from a population of trusts, and then 100 cases per trust.

We stratified all 141 acute trusts by HSMR, and then used sampling to ensure that the trusts were representative for teaching status, size, and location. Using the hospital administration system in each of the trusts, staff trained in the study methods randomly selected the case records of 100 patients who had died in hospital during the index year. If a case record could not be found, a substitute patient was randomly selected. Information on missing case records was recorded (age, sex, admitting specialty, reason why missing) to check for sampling bias. Through assiduous searching, only 5.3% of records were missing. We excluded obstetric, psychiatric, and paediatric patients (who accounted for <5% of all hospital deaths in England and Wales in 2012).

Definitions

For each case, reviewers were initially asked to judge whether there had been any problem in care that had contributed to the patient’s death. We defined problems in care as patient harm resulting from acts of omission (inactions such as failure to diagnose and treat according to evidence based guidelines), acts of commission (affirmative action such as incorrect treatment or management), and harm as a result of unintended or unexpected complications of healthcare. This definition was seen as more helpful than adverse event, patient safety incident, or error because it focuses beyond single discrete incidents to take a wider view of the overall quality of care provided and its contribution to a patient’s death. The definition was also more likely to ensure that deaths related to failure to act (omissions) were recognised, particularly if these occurred over days or weeks.

For each case where a problem in care had been identified, reviewers were asked to make a judgment as to the avoidability of that death. Some problems in care can result from exemplary clinical practice (for example, where there is a known risk of a complication that could lead to death such as a patient experiencing an intracerebral bleed when a thrombolytic drug had been appropriately administered after myocardial infarction) and would not be regarded as avoidable. In other cases, patients may have experienced a problem in care but their concurrent illness was so complex or severe that even if the problem had contributed to their death, the death itself was not judged avoidable during that admission.

Among the patients in whom an avoidable event had occurred, reviewers were asked to assess the likelihood of the death being avoidable on a Likert scale (table 1). For the analyses, we defined the proportion of avoidable deaths in a trust as those where the likelihood of avoidability was judged to be more than 50% (grade 4-6 on the scale). This included deaths that were “definitely preventable,” “strong evidence it was preventable,” and “probably preventable.”

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Table 1 | Prevalence of avoidable deaths

Grade of avoidability*	Definition of grade	2009† (n=1000)	2012/13‡ (n=2400)	Overall (n=3400)
2	Slight evidence of avoidability	28 (2.8)	87 (3.6)	115 (3.4)
3	Possibly avoidable but not very likely, less than 50-50	33 (3.3)	68 (2.8)	101 (3.0)
4	Probably avoidable, more than 50-50	29 (2.9)	45 (1.9)	74 (2.2)
5	Strong evidence of avoidability	20 (2.0)	25 (1.0)	45 (1.3)
6	Definitely avoidable	3 (0.3)	1 (0.0)	4 (0.1)
4-6	>50% likelihood	52 (5.2)	71 (3.0)	123 (3.6)

*Reviewer assessed using Likert scale.
†"Was the patient's death due to problems in the healthcare or did problems in healthcare contribute to the death?"
‡"In your judgment, is there some evidence that the patient's death was avoidable if the problem/s in healthcare had not occurred?"

The review process

Several activities that have been shown to improve reliability were incorporated in the review process:[17 18 20-22] the use of experienced clinicians, one day reviewer training, provision of written guidance, ongoing support from the principal investigator (HH), the opportunity to raise and discuss questions with a more experienced reviewer, and the use of a structured medical review form.

We recruited 67 doctors, all of whom had extensive experience as generalists (66% currently practising, and 34% recently retired), and many were already engaged in case record reviews in their own trusts. When necessary, specialist medical advice was available either from other reviewers within the group or from elsewhere. This was most often used to obtain a surgical opinion when a reviewer came from a medical specialty.

Reviewers were allocated to trusts with which they had no previous connection. As reviews took place on site, reviewers were able to request additional materials such as laboratory reports stored on computer, if these were missing from the clinical record. All deaths considered to have an element of avoidability were discussed with an expert reviewer. This aimed to reduce the risk of false positive results and increase the reliability of the decision.

The inter-rater reliability (the level of agreement between reviewers) of the judgment of avoidable deaths (grade 4-6) based on a random sample of 486 cases drawn from all trusts and subjected to double reviews was consistent with that of previous studies (κ 0.45, 95% confidence interval 0.24 to 0.66).[13]

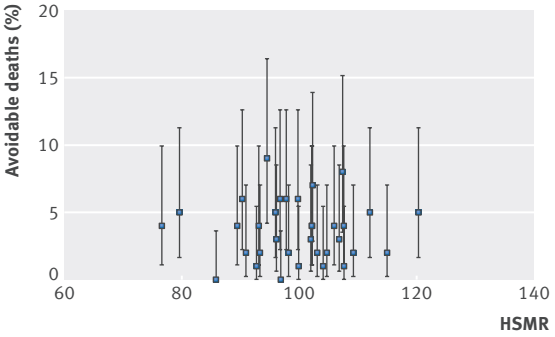

Fig 1 | Avoidable death proportion (95% confidence interval) for 34 trusts by hospital standardised mortality ratio (HSMR)

Medical review form

We asked the reviewers to consider all aspects of patient care, including nurses' and allied health professionals' notes, drug charts, and diagnostic test results. Findings were recorded on a structured medical review form. Information collected on each patient included age, sex, admitting specialty (medical; surgical), type of admission (elective; emergency), comorbidity (number of conditions and type), and overall impairment. In all cases where a problem in care was judged to have contributed to death, reviewers reported the type of problem, its timing, and any associated causative or contributory factors before making a judgment as to whether the death was avoidable. Among patients in whom there was an element of avoidability, we also asked reviewers to estimate the length of life lost. Reviewers also rated overall quality of care on a scale from very poor to excellent, using a validated method,[23] with free text space to provide more detail. Although reviews focused on the admissions during which death occurred, reviewers were also asked to identify problems that occurred before that admission if these seemed to have contributed to a patient's death.

The study design was similar in both data collection periods, although some minor improvements were made in 2012/13 based on our experiences in 2009. Within the medical review form: some additional information on mental capacity (dementia, mental illness, and learning difficulties) and end of life care were included; questions related to comorbidities were simplified; and the question on avoidability was rephrased to improve clarity: "Was the patient's death due to problems in the healthcare or did problems in healthcare contribute to the death?" (2009); "In your judgement, is there some evidence that the patient's death was avoidable if the problem/s in healthcare had not occurred?" (2012/13).

Analyses

We entered anonymised data onto EpiData 3.1 and analysed it using Stata (versions 12 and 13) software. Data on trust HSMR were obtained from Dr Foster and SHMI from the Health and Social Care Information Centre.

Linear regression was used to investigate the association between trusts' hospital-wide SMRs and avoidable death proportions (aggregated for the trust) rather than correlation because the correlation is subject to downward biased estimates if there is random measurement error in one of the variables. In this study the scope for random error was far greater for avoidable death proportions (owing to sampling 100 deaths for each trust) than for hospital-wide SMRs (based on all deaths and admissions in a year). In contrast, downward bias in the estimates of a regression coefficient (regression dilution bias) arises in the presence of random error in the independent variable but will not arise from random error in the dependent variable which, in

this analysis, was avoidable death proportion.[24] The (aggregated) trust proportion was used as the dependent variable. No weights were used because the sample size was the same for all trusts.

Binomial regression models for proportions that allow for extra-binomial variation were also fitted, but presented results are confined to the simpler linear regression models as the conclusions were the same. The count of avoidable deaths was used and the sample size was included as the offset.

Patient involvement

There was no patient involvement in this study.

Results

Proportion of avoidable deaths

The proportion of patients where death was judged to be avoidable (more than 50% likely; grade 4-6) was 123 (3.6%, 95% confidence interval 3.0% to 4.3%, table 1). Fewer deaths were deemed avoidable in 2012/13 (3.0%, 2.4% to 3.7%) than in 2009 (5.2%, 3.8% to 6.6%).

Association between avoidable death proportion and hospital-wide SMRs

Figure 1 shows the proportion of avoidable deaths by HSMR for the 34 trusts. Overall, based on 34 trusts, there was little evidence of an association between HSMR and the proportion of avoidable deaths in a hospital (table 2). The regression coefficient was 0.3 (95% confidence interval −0.2 to 0.7; P=0.23). Thus, a one standard deviation in HSMR such as between 105 and 115, was associated with an increase of only 0.3% (95% confidence interval −0.2% to 0.7%) in the proportion of avoidable deaths. The regression coefficient was similar in both time periods (0.1 and 0.3).

A similar positive but non-significant association was observed for SHMI (0.3, 95% confidence interval −0.3 to 1.0). Figure 2 shows the proportion of avoidable deaths for the 34 trusts.

Discussion

Only weak positive associations were observed between the proportion of avoidable deaths in a trust and two commonly used standardised mortality ratio metrics, the hospital standardised mortality ratio (HSMR) or summary hospital level mortality indicator (SHMI), neither reaching statistical significance. A difference in standardised mortality ratios (SMRs) between 105 and 115 would be associated with a difference in the proportion of avoidable deaths of only 0.3 percentage points (95% confidence interval −0.2% to 0.7%). Even if a larger sample of trusts and cases was taken, it would be unlikely to reveal a clinically important association, even if it achieved statistical significance. Thus, hospital-wide SMRs do not provide a useful indication of the proportion of avoidable deaths in a trust.

The absence of even a moderately strong association is a reflection of the small proportion of deaths (3.6%) judged likely to be avoidable and of the relatively small variation in avoidable death proportions between trusts. This confirms what others have demonstrated theoretically—that is, no matter how large the study, the signal (avoidable deaths) to noise (all deaths) ratio means that detection of significant differences between trusts is unlikely.[6]

Although there was no statistically significant difference over time in the proportion of deaths in which reviewers judged there to be an element of avoidability (that is, including even a slight possibility) between 2009 (11.3%) and 2012/13 (9.4%), there was a statistically significant difference in the proportion of deaths deemed to be more than 50% likely to have been avoidable (5.2% *v* 3.0%). An improvement in quality of care is only one of five factors that may have contributed. Firstly, in 2012/13 patients were sicker; a higher prevalence of several key comorbid conditions was reported by reviewers (for example, metastatic cancer 11.4% *v* 6.0%; chronic obstructive pulmonary disease 36.7% *v* 13.2%; heart failure 21.1% *v* 8.8%). Whether or not this was a real difference or reflected greater propensity to record these comorbidities, the impact on reviewers is likely to mean they were less likely to judge a death avoidable. Secondly, reviewers' awareness of the use of "do not attempt resuscitation" orders was probably greater as a result of the wider use of highly visible forms in the case records plus changes to the medical review form, which drew their attention to such orders. Thirdly, there was a minor difference in the wording of the question about attribution of avoidability. And finally, a perception is that there has been a change in culture in the National Health Service over those years,[25] which might have

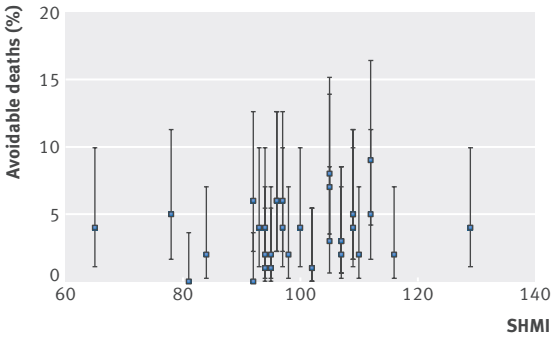

Fig 2 | Avoidable death proportion (95% confidence interval) for 34 trusts by summary hospital level mortality indicator (SHMI)

Table 2 | Regression coefficients (95% confidence intervals) for relation* between avoidable death proportion and two hospital-wide standardised mortality ratio (SMR) metrics, the hospital standardised mortality ratio (HSMR) and the summary hospital level mortality indicator (SHMI)

	HSMR		SHMI	
Sample of trusts	Regression coefficient (95% CI)	P value	Regression coefficient (95%CI)	P value
Overall (n=34)	0.3 (-0.2 to 0.7)	0.23	0.3 (-0.3 to 1.0)	0.29
2009 (n=10)	0.1 (-0.1 to 1.3)	0.82	-0.02 (-1.0 to 0.6)	0.56
2012/13 (n=24)	0.3 (-0.2 to 0.7)	0.26	0.5 (-0.4 to 1.3)	0.24

*Regression coefficient can be interpreted as percentage point increase in avoidable death proportion for 10 point increase in SMR.

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led to an increasing reluctance of reviewers to criticise other clinicians.

The weak positive (although non-significant) association between SMRs and avoidable death proportion seen in 2012/13, but absent in 2009, may have been that the reviewers were aware that the principal aim during this second phase of data collection was to investigate such an association. As such, they knew that the sample of trusts had been stratified according to HSMR and could easily have found out the HSMRs for the trusts they were studying. In 2009, reviewers were not made aware that the trusts were a stratified sample.

Strengths and limitations of this study

This is the largest nationally representative retrospective case record review to have been conducted in England and one of the largest worldwide. It is the first published comparison of hospital-wide SMRs and estimates of the frequency of avoidable deaths based on detailed clinician reviews of case records.

The lack of a significant association between hospital-wide SMRs and avoidable death proportions may reflect the methodological limitations of both types of measure. Hospital-wide SMRs, being based on routine administrative data, are unable to take into account the severity of a patient's primary condition. In addition, they are subject to variation between trusts as regards clinicians' diagnostic practice, thoroughness of recording comorbid conditions, use of palliative or end of life coding (which affects HSMR but not SHMI), and availability of alternative facilities for patients where death is imminent. Even where adjustment for case mix is carried out in an attempt to account for some of these factors, it has the potential to increase rather than to reduce bias in the SMR as an indicator of the quality of care.[26]

Retrospective case record review using two reviewers has only moderate reliability, reflecting the subjective element in judgments of avoidability and the quality of care. Despite adopting practices known to improve reliability (training, use of a standard review form, availability of expert advice), the inter-rater reliability was only moderate (κ 0.45), similar to that reported in other studies. High reliability can only be achieved by using five or more reviewers for each case record, which was not feasible.[27] To minimise this limitation we ensured that the 100 deaths in each trust were allocated to several reviewers from different specialist backgrounds rather than all being reviewed by one person.

Another limitation may have exaggerated the strength of any association. Although the reviewers were not informed of the trust's HSMR or SHMI, they could easily have obtained such information. They may also have had a pre-existing view of the quality of the trust based on reputation and hearsay. Such knowledge may have influenced their judgments as to the occurrence of problems in care and the avoidability of deaths. This would have contributed to overestimating the association between hospital-wide SMR and avoidable death proportion.

Another potential limitation was restricting the reviewing to doctors. Although doctors were instructed to consider not only the medical documentation in the case records but also the documents from nurses and other professionals, the inclusion of reviewers from those backgrounds may have taken a different view of the avoidability of deaths.[28]

Finally, we chose to define avoidable as being at least a 50% likelihood of the death being avoidable, a definition that has wide credibility and acceptability. Analyses based on an even broader definition of avoidability, including those with only slight evidence of avoidability, resulted in larger although still non-significant regression coefficients with wider confidence intervals (HSMR 0.6, 95% confidence interval −0.2 to 1.5; SHMI 0.7, 95% confidence interval −0.7 to 2.0). A difference in SMRs between 100 and 115 would be associated with a difference in the proportion of such deaths of only 0.9%.

Implications for policy

Despite the methodological limitations described, the low rate of avoidable deaths combined with the absence of a significant association between hospital-wide SMRs and avoidable death proportions suggests that neither metric is a helpful or informative indicator of the quality of a trust. It is potentially misleading to the public, clinicians, managers, and commissioners to praise or condemn a trust on the basis of either measure. In addition, although it was beyond the scope of this study, neither measure should be used as a screening test (smoke alarm) to identify poor quality trusts until its validity for that purpose has been rigorously evaluated and demonstrated.

There are, however, two ways in which consideration of hospital deaths may assist in assessing and improving quality. Firstly, there is evidence of the value of SMRs for specific groups of patients, but this requires not only that death is a frequent outcome (such as critical care or high risk major surgery) but also that high quality clinical data are available that allow adequate risk adjustment. Secondly, routinely reviewing case records of patients who die in trusts provides an opportunity for identifying local quality problems and stimulating improvements. It has clinical credibility by taking account of the complexity of patients' conditions and care, and it can indicate whether or not poor care was responsible for any death. Although some form of mortality reviewing takes place in all acute trusts in England, standardisation of the process (selection of deaths, review forms, training of reviewers, judging avoidability) would help ensure adequate rigour throughout the hospital sector.

Implications for research

Four potentially productive lines of inquiry could be pursued. Firstly, we will explore the relation between avoidable deaths and other measures of safety such as healthcare acquired infections, staff views of the safety of their hospital, and patient incident reports. Secondly, the validity of other possible metrics based on avoidable

deaths, such as weighted means of grades of avoidability, could be explored. Thirdly, the method of determining avoidability might be improved through exploring other ways of defining and measuring the likelihood of certain events being avoidable. In addition, it would be interesting to explore the sensitivity of results to blinding reviewers to the identity of the hospital, although this would be expensive given the vast number of references to the identity of a hospital in a case record. Comparison with case records of patients who survive might also prove to be productive. Finally, by combining our data with that from other countries we could assess the impact of increasing the power of the analysis.

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Ethical approval: This study was approved by the NRES Committee London-Central. Research governance approval was granted by each participating trust.

Data sharing: No additional data available.

Transparency: The lead author (HH) affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

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