Interpretation of Hospital Mortality Measures

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Purpose and Summary of Document:

This document provides a brief description of hospital mortality measures to help put the Betsi Cadwaladr University Health Board (BCUHB) Mortality Publications in context.

1.0 Introduction

Death is a unique and universal event, clearly defined and well captured by data systems. Cause and age of death provide an instantaneous view of a population's health status. However, as population survival improves over time and populations age, mortality measures give a less accurate picture; indicators of morbidity such as the prevalence of chronic diseases and disabilities then increase in importance.

This document describes hospital mortality measures and aids in their understanding and interpretation.

2.0 Hospital Mortality Measures

2.1 Calculating Hospital Mortality Measures

Because hospitals in Wales are not the same size and complexity, it is not possible to simply compare the number of people who die each year within them.[1] The risk of a patient dying during a stay in hospital is related to a number of factors including the patient's gender, age, condition that they are suffering from, and co-existing diseases.[2]

To allow for differences in the prevalence of these factors between different hospital patient populations so that variations in death rates due to the quality of care can be highlighted, mortality indices are calculated. However, as there is no gold standard procedure to do this, different organisations have chosen alternative ways to count observed deaths and use different methods of risk adjustment. Hence, a variety of measures are in use - HSMR, SHMI and RAMI - which produce different estimates of mortality rates.[3] For example, a study which compared four different methods across 83 hospitals in America, found that 28 designated as the 'worst' mortality hospitals by one company, 12 appeared in the 'best' category when different methods were used.[4]

In North Wales, we mainly use the RAMI – risk-adjusted mortality index. This adjusts for variables such as the underlying health of patients being treated and the procedures undertaken.[1] The measure, calculated on a rolling 12-month basis, is provided by an external healthcare intelligence service called CHKS. Using a large database containing several million annual episodes from Wales, England and Northern Ireland, (Scotland is included in the 2014 model), a normative database of case-level hospital spell data is constructed including: age, sex, length of stay, method of admission (emergency, transfer and other including elective), clinical grouping (Healthcare Resource Group-HRG), ICD10 primary and

secondary diagnoses, OPCS primary and secondary procedures, hospital identification, and discharge method.[5]

The average RAMI is described as 100 and statistically, it is expected 50% would be greater, and 50% less than 100 in a "normal" population. The RAMI model is rebased annually, by recalculating the norms based on a more up to date data period. This process ensures that the database norm returns to 100. After rebasing, the database norm will typically then fall again (from 100) from the moment it goes live until it is recalibrated once more.[5] In some instances the model itself is also adjusted e.g. between RAMI 2012 and RAMI 2013 the palliative care codes were amended.

The interpretation of hospital mortality measures like the RAMI is problematic. Patients die in hospital for many different reasons; quality of care is only one of these.[3] Hospitals have no control over many of the external factors, yet they can all result in an increased number of deaths, which increases the ratio of observed to expected deaths, and therefore the RAMI.

2.2 Factors which influence RAMI

2.2.1 Chance Variation

With any statistical measure, the numerical value will vary chance alone (common cause variation).[2] A hospital may have a stable underlying death rate; however, the observed monthly rate may fluctuate because of chance variation.[1] For that reason, the reporting of mortality ratios should ideally be set within statistical control limits that represent the likelihood of random effects. However, this is not currently the norm at an all-Wales or Health Board level.[2]

2.2.2 Coding Quality

Whenever a patient is discharged from or dies in hospital, data about their disease/s and any operations performed are summarised using classification codes and submitted as hospital episode statistics (PEDW) to a national database.[3] Calculation of RAMI relies on the quality and completeness of an individual Health Board's clinical coding drawn from case notes; risk factors can only be adjusted for that can be identified and measured accurately. The more accurate and complete the coding and the case note information, the more reliable the risk-adjusted mortality data is.[1]

Studies have found considerable variation in choice of coding and coding depth (average number of diagnoses per patient[6]) between clinical coders. This means that expected deaths, and so mortality ratios, can vary considerably depending on how patients have been coded.[3] There may be

differences of interpretation of case notes by coders in different hospitals to the point of coming to different conclusions about the primary diagnosis; this will be determined by the quality of the case notes.[2] Hospitals also vary in the degree to which secondary diagnoses (co-morbidities) are captured which will have a major influence on the RAMI score.[7] The true risk of death for the poorly coded patient will be higher than that which appears on the records and so the observed rate of death is likely to be higher than the incorrect low "expected" death rate.[2]

The national coding target in Wales is 98% for any rolling 12 months. Generally, the Health Board achieves this target. However, the measure does not tell you anything about choice and depth of coding.

2.2.3 Use of Palliative Care Codes

Patients whose admission includes the palliative care code are considered 'very likely' to die and so these patients can have a profound effect on hospital mortality measures.[3] It is, therefore, important that palliative care is coded as such to ensure that RAMI is not artificially inflated.[1] Since 2013, this also applies to the end of life care pathway coding.[2]

Between RAMI 2012 and RAMI 2013 the following changes were made.[5]

- Z515 – patients with a palliative care code were previously not included in the model derivation. In 2013 this was amended to include records coded with Z515 palliative care in the derivation of the coefficients, thereby ensuring condition based risk are as accurate as possible.
- Z518 – generalised palliative care or end of life care codes were previously assigned a high risk weight within the model but have been excluded from the calculation of the expected deaths in 2013 version.

The Health Board is improving its coding processes to ensure that it captures all relevant information from the case notes. In terms of the end of life care pathway, new case notes now have Z518 filed in the front section alongside the DNACPR forms.

2.2.4 Location of death

The RAMI is heavily influenced by the proportion of deaths in a community that occur in hospital. A CHKS Insight report quotes a scenario where a Trust has 78% (compared to an expected 56%) of its resident population deaths occurring in hospital, and this raised its RAMI from 100 to 139.[2]

Table 1 shows the percentage of deaths across North Wales, by place of occurrence for 2014. A total of 7,550 deaths were recorded for the 6 North Wales Local Authority areas covered by BCUHB. Of these, just over half occurred in an NHS hospital in our area.

Table 1: Percentage of deaths by place of occurrence and local authority, North Wales, deaths registered in 2014

		Home	Hospital	Care home	Other communal establishment	Elsewhere
Isle of Anglesey	**Male**	31.6	51.3	12.0	1.6	3.5
	Female	23.0	51.7	22.5	1.2	1.5
	Persons	27.2	51.5	17.4	1.4	2.4
Gwynedd	**Male**	27.1	58.1	10.1	0.5	4.2
	Female	19.7	52.9	24.5	1.2	1.7
	Persons	23.2	55.3	17.8	0.9	2.8
Conwy	**Male**	22.1	54.8	12.0	8.6	2.5
	Female	16.1	55.4	19.2	8.4	0.9
	Persons	19.1	55.1	15.6	8.5	1.7
Denbighshire	**Male**	19.4	57.0	14.8	5.4	3.3
	Female	19.6	49.4	25.7	4.6	0.8
	Persons	19.5	53.1	20.4	5.0	2.0
Flintshire	**Male**	23.4	60.5	8.0	3.9	4.3
	Female	18.4	56.3	18.2	5.7	1.5
	Persons	20.9	58.4	13.0	4.8	2.9
Wrexham	**Male**	25.3	53.5	12.9	6.6	1.8
	Female	18.8	51.2	23.9	5.2	0.8
	Persons	22.0	52.3	18.5	5.9	1.3

Source: ONS

2.2.5 Deprivation

In general, more deprived communities report poorer health outcomes; this is important as the RAMI model does not specifically adjust for deprivation. Hospitals serving more deprived populations are also likely to be admitting patients with more complex medical problems than hospitals serving less deprived areas; consequently if the coding systems for co-morbidities do not adequately capture these differences then the hospitals serving poorer populations will look worse than they should in terms of RAMI.[2]

Figure 1 shows the levels of deprivation across BCUHB at Lower Super Output Area (LSOA) level; darker shading represents higher levels of deprivation. Table 2 shows population by deprivation fifth by Health Board and Local authority. The six North Wales local authorities have between 4% and 16% of their population in the most deprived fifth, with BCUHB at 12% overall.

Figure 1:

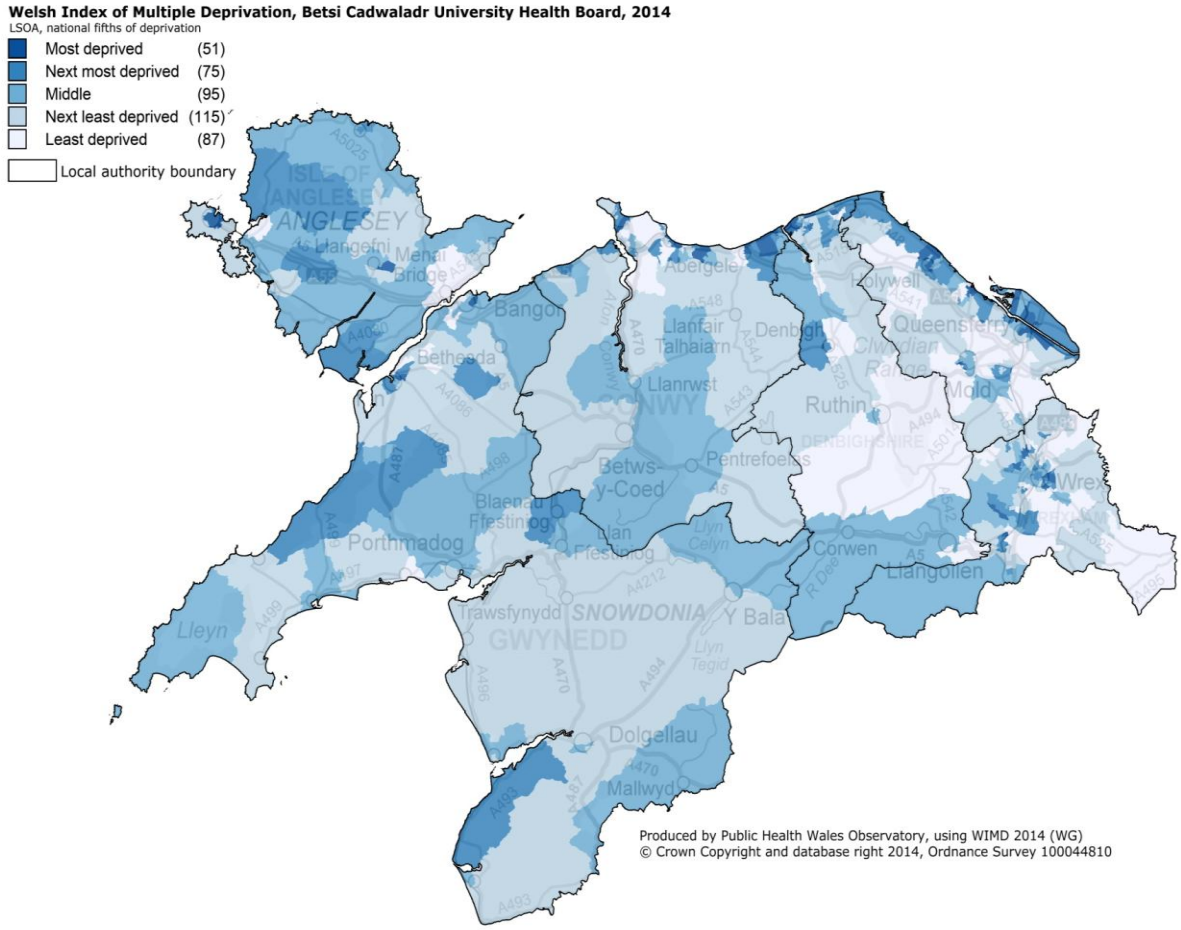

Table 2:

Population* by deprivation fifth, Wales health boards and local authorities, 2013

	Least deprived		Next least deprived		Middle		Next most deprived		Most deprived	
	Count	%	Count	%	Count	%	Count	%	Count	%
Besti Cadwaladr UHB	142,700	21	185,200	27	156,900	23	125,500	18	81,700	12
Powys tHB	14,700	11	69,900	53	31,000	23	12,500	9	4,600	4
Hywel Dda UHB	30,600	8	108,800	28	140,400	37	75,500	20	28,700	7
Abertawe Bro Morgannwg UHB	121,800	23	68,500	13	91,000	17	110,500	21	128,900	25
Cardiff & Vale UHB	166,600	35	79,300	17	57,400	12	62,900	13	112,700	24
Cwm Taf UHB	30,500	10	31,300	11	47,000	16	98,400	33	87,800	30
Aneurin Bevan UHB	105,300	18	82,100	14	111,000	19	131,000	23	149,600	26
Isle of Anglesey	9,800	14	12,900	18	26,300	37	10,400	15	10,900	15
Gwynedd	12,700	10	49,500	41	38,500	32	16,400	13	4,800	4
Conwy	25,700	22	33,400	29	18,200	16	23,600	20	15,000	13
Denbighshire	22,800	24	15,900	17	26,300	28	14,200	15	15,300	16
Flintshire	44,700	29	42,000	27	19,700	13	29,300	19	17,500	11
Wrexham	27,100	20	31,600	23	28,000	21	31,700	23	18,100	13
Powys	14,700	11	69,900	53	31,000	23	12,500	9	4,600	4
Ceredigion	15,800	21	21,800	29	31,900	42	5,400	7	1,200	2
Pembrokeshire	5,400	4	43,300	35	42,200	34	22,400	18	10,000	8
Carmarthenshire	9,400	5	43,700	24	66,300	36	47,700	26	17,500	9
Swansea	77,300	32	26,900	11	46,100	19	32,000	13	58,000	24
Neath Port Talbot	15,400	11	17,100	12	24,200	17	42,000	30	41,100	29
Bridgend	29,000	21	24,500	17	20,700	15	36,400	26	29,800	21
Vale of Glamorgan	62,600	49	15,700	12	15,600	12	15,000	12	18,200	14
Cardiff	103,900	30	63,600	18	41,800	12	47,900	14	94,500	27
Rhondda Cynon Taf	27,100	11	26,800	11	34,000	14	77,800	33	70,400	30
Merthyr Tydfil	3,400	6	4,500	8	13,000	22	20,700	35	17,400	29
Caerphilly	21,000	12	21,600	12	40,800	23	46,400	26	49,400	28
Blaenau Gwent	0	0	1,200	2	15,100	22	20,900	30	32,500	47
Torfaen	9,800	11	21,300	23	14,300	16	23,600	26	22,400	24
Monmouthshire	37,100	40	23,000	25	20,200	22	11,900	13	0	0
Newport	37,400	26	15,000	10	20,600	14	28,200	19	45,300	31
Wales	**612,100**	**20**	**625,100**	**20**	**634,600**	**21**	**616,400**	**20**	**594,100**	**19**

Produced by Public Health Wales Observatory, using WIMD 2014 (WG) and MYE (ONS)

*Rounded to the nearest 100 persons

2.2.6 Lifestyle

Many healthcare outcomes are due to lifestyle choices such as smoking, obesity and alcohol. Many lifestyle choices are driven by material deprivation.

Patient lifestyle factors such as smoking and alcohol are not recorded in PEDW data. This means that calculating the risk of dying based on patients lifestyles has to use proxy measures instead, and this is largely achieved using a postcode as a proxy for deprivation, and hence lifestyle, risk factors.[3] However, as we have seen, the RAMI model does not adjust for deprivation.

Furthermore, the considerable lag time between changes in lifestyle factors in the population and a subsequent impact on population mortality measures means that it is not valid to use recent lifestyle data to interpret the RAMI as this will reflect historical patterns of behaviour.

In North Wales in 2014:

- 56% of population is classed as overweight or obese, better than the all-Wales figure of 58%
- 21% of population smokes, same as the all-Wales figure
- 41% drink more than the recommended weekly alcohol amounts, same as the all-Wales figure
- 33% of adults are active on 5 or more days per week, better than the Welsh average of 30%
- 35% of people eat the recommended amounts of fruit and vegetables each day, better than the Welsh average of 33%

2.2.7 Underlying Life Expectancy of Population

The RAMI does not allow for differences in underlying life expectancy in populations served by different hospitals.[2] Hospitals serving poorer populations will be treating patients that have a lower life expectancy than richer populations. This difference is not due to the quality of care received, but is due instead to a "generationally inherited extra risk", and a higher prevalence of unhealthy risk factors such as tobacco smoking.[2] Even when hospital care is optimal the outcomes are going to be poorer because the underlying risks of death are greater.

Table 3 shows the life expectancy at birth for males and females in North Wales born between 2010 and 2012. For men, the life expectancy in all North Wales counties is higher or the same as the Welsh average. For women, the life expectancy is higher than the Welsh average in Anglesey, Gwynedd, Conwy and Flintshire; in Denbighshire and Wrexham, it is slightly below the Welsh average.

Table 3: Life Expectancy at Birth

Life expectancy at birth, 2010-12	Males	Females
Wales	78.2	82.2
Isle of Anglesey	78.5	83
Gwynedd	78.8	83.1
Conwy	79	82.6
Denbighshire	78.3	81.2
Flintshire	79	82.4
Wrexham	78.2	82

Source: StatsWales (Office for National Statistics)

2.2.8 Community health services (primary care, hospice and care home provision)

Alterations in community health services can have a large affect on hospital mortality rates. In their report, the Faculty of Public Health describes a scenario in which a local authority opened a hospice, and then the nearby hospital's HSMR and SHMI declined sharply.[3]

In addition, other primary care related health service factors may exacerbate the risk in hospital. For example, if diagnosis of a serious condition occurs later in the course of a disease then the patient will present to hospital sicker than they would have been if diagnosed earlier.[2]

2.2.9 Statistical Model Used

The statistical model that is used to calculate RAMI may be altered from one year to the next; these changes can produce different pictures of welsh hospitals.[2] For example, outputs from the 2012 model applied to Wales differ considerably from the 2013 model applied to the same hospitals using the same data for the same time period. This is largely due to changes in the palliative care and end of life care codes used in the calculation of RAMI.

2.2.10 Quality of Hospital Care

There is no argument that RAMI can be influenced by the quality of care, but we do not know whether a change in RAMI is due to a change in care, or in one of other of the many non-hospital factors that influence the model previously described.[2]

Auditing of care records has found that only around 1 in 20 deaths in hospital has any factors that might have impacted on the inevitably of the patient dying – i.e. a preventable death.[3] Deaths due to failings in care reflect a very small proportion (about 1 in 600) of all admissions, and it is quite possible for a hospital to have a low mortality measure while nevertheless offering poor quality care. In addition, most organisations perform well in some areas and less well in others, adding to the limitations of using a single overall indicator as a measure of quality.

Furthermore, RAMI largely compares Welsh units with units in England – which have a different set of data related incentives, including payment by results which maximises coding and coding rules.

2.2.11 Summary

RAMI is an important source of data which can help to highlight where further investigation is required. When we read RAMI reports, especially when we compare RAMI scores between organisations, we need to ask ourselves[1]: Are we (really) different? Do we know why? What are we doing about the difference? Are we improving against ourselves? Are we improving relative to everyone else?

Furthermore, RAMI should be used in conjunction with other measures of quality including: patient experiences and feedback; safety measures; healthcare associated infections data. This allows you to attain a wider picture of how the organisation is performing and whether patient care is being compromised in any particular area.

According to the Faculty of Public Health[3], RAMI should **not** be used:

- To compare the quality of one hospital to another e.g. league tables
- To attribute 'preventable deaths' to individual hospitals
- To falsely assume that a low or 'within expected limits' mortality ratio implies good quality of care and overlook clinical or organisational failings that are causing harm to patients
- To only focus attention on hospitals when attempting to interpret hospital mortality statistics, instead of also considering the impact of external factors such as community pressure or hospice facilities
- To assume that there are such things as 'good' hospitals and 'bad' hospitals. In reality, most hospitals are large complex organisations with both good and bad elements across different departments and sites.

3.0 Acknowledgements

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4.0 References

1. Cwm Taff University Health Board. *Understanding and interpreting mortality data.* N.D. Available at: http://www.cwmtafuhb.wales.nhs.uk/opendoc/223642 (last accessed 16/12/15)
2. Palmer S. 2014. *A Report to the Welsh Government Minister for Health and Social Services to provide an independent review of the risk adjusted mortality data for Welsh hospitals, considering to what extent these measures provide valid information.* Available at: http://wales.gov.uk/topics/health/publications/health/reports/mortality-data/?lang=en (last accessed 16/12/15)
3. Faculty of Public Health. 2014. *Hospital Mortality Rates: Position Statement.* Available at: http://www.fph.org.uk/uploads/Position%20statement%20-%20hospital%20mortality%20rates.pdf (last accessed 16/12/15)
4. Shahian DM, Wolf RE, Iezzoni LI, Kirle L *et al*. 2010. Variability in the Measurement of Hospital-wide Mortality Rates. *New England Journal of Medicine*. 363,2530-9.
5. Cardiff & Vale UHB. Risk Adjusted Mortality Index. Available at: http://www.cardiffandvaleuhb.wales.nhs.uk/rami (last accessed 16/12/15)
6. Association of Public Health Observatories. *Dying to know. How to interpret and investigate hospital mortality measures*. October 2010. Available at: http://www.apho.org.uk/resource/view.aspx?RID=95780 (last accessed 16/12/15)
7. 1000 Lives Plus. *A Guide to Measuring Mortality*. 2010. Available at: http://www.1000livesplus.wales.nhs.uk/sitesplus/documents/1011/T4I%20%287%29%20Mortality%20Measurements%20%28Feb%202011%29%20Web.pdf (last accessed 16/12/15)