Public Health England

Protecting and improving the nation's health

Using ONS mortality data – taking account of changes to cause of death coding from 2014

Background

The Office for National Statistics (ONS) uses software to automate the translation of cause of death information on death certificates from text to International Classification of Diseases (ICD) codes. Until December 2013, ONS used software provided by the National Center for Health Statistics (NCHS) in the USA. From 1 January 2014, ONS changed the software used to code causes of death to a package called IRIS. Eurostat (the statistical office of the European Union) has supported the development of IRIS which is now managed by the IRIS Institute hosted by the German Institute of Medical Documentation and Information in Cologne.

The Tenth Revision of the ICD (ICD-10) was introduced for coding deaths in England and Wales in 2001. Until December 2010, ONS used ICD-10 version 2001.2. From 1 January 2011, ONS used ICD-10 version 2010. From January 2014, ONS is using ICD-10 version 2013.

Changes in 2014

Changes introduced by the use of the IRIS software include:
- major updates to the ICD-10 approved by the WHO. These include changes to the use of codes in the cancer Chapters C and D (Neoplasms)
- a small number of changes to the coding of specific conditions to bring previous coding practice into line with international coding rules

The impact of the coding changes include statistically significant percentage increases in the deaths allocated to an underlying cause in seven ICD-10 chapters, and significant decreases for five chapters when coded in ICD-10 v2013 (IRIS).

Comparability ratios

ONS carried out a dual coding study to analyse the differences in coding brought about by the changes in 2014. The results of this study can be found at: http://www.ons.gov.uk/ons/rel/subnational-health3/impact-of-the-implementation-of-iris-software-for-icd-10-cause-of-death-coding-on-mortality-statistics/england-and-wales/index.html

For the study, ONS sampled 38,718 deaths drawn from one week each in January, April, July and October 2012. The sample represents 7.8% of all deaths in 2012. By coding these deaths using both ICD-10 v2010 (NCHS) and ICD-10 v2013 (IRIS), an estimate of the impact of the changes can be made by calculating comparability ratios.

Comparability ratios are simply the number of deaths coded to an underlying cause in the new version of ICD-10, divided by the number of deaths coded to the same underlying cause in the old version of ICD-10. For example:

ICD-10 v2010 (NCHS)	Number of deaths coded to dementia = 2,766
ICD-10 v2013 (IRIS)	Number of deaths coded to dementia = 2,962
2962/2766 = 1.071	

Dementia defined using ICD-10 codes F01 and F03

In this example, 7.1% more deaths were coded to dementia in the new version when compared to the same underlying cause in the old version (using ICD-10 codes F01 and F03). If the ratio had been 1, the number of deaths coded to dementia would have been the same in both versions. That may not necessarily mean that no changes took place, however. Some causes of death in the new version may 'gain' some deaths from some causes and in turn 'lose' some deaths to other causes. If these movements in and out are balanced, the number of deaths in both v2010 and v2013 will be the same. ONS has used their dual coded data to publish comparability ratios for all chapters in ICD-10, based on data for all persons and all ages.

The dual coded data include both 'old' and 'new' ICD codes, as well as the age and sex of the deceased. These data have been used by the Knowledge and Intelligence Service in Public Health England (PHE) to calculate a set of comparability ratios (provided in an accompanying table to this report). These were calculated for each sex rather than for all persons and split by age into under 75s and 75s and over. Ratios have been calculated for indicators included in current PHE products such as the Public Health Outcomes Framework and local authority Health Profiles. They could, however, be calculated for any other cause (or group of causes) as needed. The ratios are presented with 95% confidence intervals,

which were calculated using the same method used by ONS (Rooney, Griffiths and Cook, 2002).

While the ONS comparability ratios provide a broad indication of change, the PHE ratios allow a more detailed assessment of the impact of the coding change to be made. They can be used to adjust numbers of deaths (and to calculate adjusted mortality rates), by sex and broad age group, using the methods described in this report. This detailed adjustment is particularly important as for some causes the bridge coded data indicate differences between the sexes, or between age groups.

How to apply the comparability ratios

It is normally recommended that comparability ratios are applied to historic data, to make them comparable to data coded in the most recent version of the ICD. It is only necessary to use comparability ratios if we are looking at trends in causes of death, or grouping years of mortality data together.

In reporting cause-specific trends, ONS have generally taken the position that they do not report adjusted numbers of deaths. Instead they have tended to report actual numbers of deaths and added warnings to users to note the likely impact of ICD revisions. Where comparability ratios are applied, it should be made clear that these are 'adjusted' numbers.

The ratios can be applied to mortality data in England and Wales back to 2011, the year that ICD-10 v2010 was introduced. It should be remembered, however, that the ratios are based on data for 2012. Changes in the distribution of deaths between cause groups in other years may mean that the ratios are less accurate when applied to data not from 2012. This should be considered if, for example, adjusted trend data do not appear plausible or consistent.

The comparability ratios can also be used to adjust mortality rates. The ratio can either be applied directly to the rate or the numbers of deaths can be adjusted before the adjusted rate is calculated. It is recommended that the latter option is used, so that the adjusted rate and its confidence interval are both based on adjusted numbers of deaths. Since the ratios are different for different age groups and for males and females, applying an overall single comparability ratio to the calculated rate would require this to be calculated taking into account the age/sex distribution of deaths by cause. If the numbers of deaths are adjusted, however, the appropriate ratio can be applied to each age/sex-specific count.

Table 1 includes an example of how deaths can be adjusted by the application of age/sex-specific comparability ratios. The age-specific ratios should be used to adjust deaths for under 75s and those aged 75 and over separately. In the example in Table 1, deaths for 2012 and 2013 are aggregated with deaths for 2014. Deaths for the earlier two years therefore require adjustment, while deaths for 2014 do not. Once the adjusted deaths have been calculated, they can be used to calculate either directly or indirectly age-standardised

rates, or crude or age-specific rates. For an SMR, deaths should be adjusted for both the reference population and study populations being compared to the reference group.

Table 1: Example: adjusting deaths using sex and age-specific comparability ratios

Age group	Comparability ratio		2012-13 deaths	Adjusted deaths 2012-13: deaths*CR	2014 deaths	Adjusted deaths 2012-13 + unadjusted deaths 2014
0 - 4	<75	1	0	0	0	0
5 - 9	<75	1	0	0	0	0
10 - 14	<75	1	0	0	0	0
15 - 19	<75	1	0	0	0	0
20 - 24	<75	1	0	0	0	0
25 - 29	<75	1	0	0	0	0
30 - 34	<75	1	0	0	0	0
35 - 39	<75	1	0	0	0	0
40 - 44	<75	1	4	4	0	4
45 - 49	<75	1	7	7	0	7
50 - 54	<75	1	27	27	2	29
55 - 59	<75	1	47	47	14	61
60 - 64	<75	1	122	122	54	176
65 - 69	<75	1	353	353	217	570
70 - 74	<75	1	924	924	526	1450
75 - 79	75+	1.086	2404	2610.744	1347	3957.744
80 - 84	75+	1.086	5106	5545.116	2834	8379.116
85 - 89	75+	1.086	6762	7343.532	3904	11247.53
90+	75+	1.086	6140	6668.04	3868	10536.04

Adjusting trend data

The ratios calculated to adjust for the change introduced by the IRIS software can only be applied back to data for 2011, when the previous coding change was introduced. PHE calculated a set of comparability ratios to allow adjustment for the 2011 changes: http://www.apho.org.uk/resource/view.aspx?RID=132837

To examine comparable trends for data before 2011, both sets of ratios should be applied. Table 2 illustrates how this should be done using numbers of dementia deaths as an example. Deaths for 2009 and 2010 are adjusted using the ratio calculated for the 2011 coding change (Column A x Column B = Column C) and then adjusted again using the ratio calculated for the 2014 change (Column C x Column D = Column E). Figure 1 shows the impact of the application of various adjustments. Without adjustment, a clear step change can be seen from 2010 to 2011 which is the result of coding change rather than a rapid increase in the number of deaths from dementia. The change between 2013 and 2014 is

less dramatic, but the adjusted numbers show that deaths from dementia have plateaued recently, rather than increased as the unadjusted numbers suggest.

Table 2: dementia deaths (ICD-10 F01, F03) England and Wales, 2009-14

Year	Reported numbers (Column A)	Comparability ratio for 2011 coding change (Column B)	Adjustment for coding change in 2011 (Column C)	Comparability ratio for 2014 coding change (Column D)	Adjustment for coding change in 2014 (Column E)
2009	16,425	1.58	25,903	1.07	27,738
2010	18,349	1.58	28,937	1.07	30,988
2011	30,256		30,256	1.07	32,400
2012	34,998		34,998	1.07	37,478
2013	37,327		37,327	1.07	39,972
2014	40,200		40,200		40,200

Figure 1: dementia deaths trend with adjustments (ICD-10 F01, F03) England and Wales, 2009-13
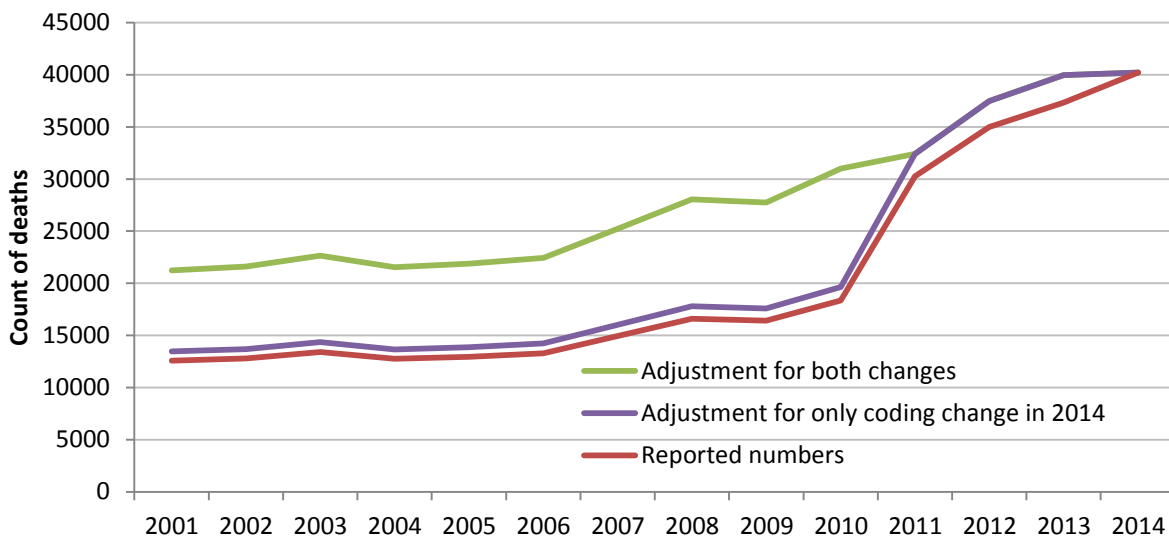
When adjusted counts of deaths are used to calculate rates or ratios, there are two potential ways of calculating confidence intervals for the statistics:

- the adjusted counts can just be used to determine the confidence intervals as if they were actual observed counts
- the rate or ratio (R) and its confidence interval (R_L, R_U) can be calculated using the original counts, and the confidence interval applied to the adjusted rate or ratio (R^*) as follows:

$$R^*_L = \frac{R_L \times R^*}{R} \quad \text{and} \quad R^*_U = \frac{R_U \times R^*}{R}$$

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While the second method is arguably more accurate, as it uses the actual observed counts to define the confidence interval, it will make little difference as long as the ratios are fairly close to 1, as they are in the majority of cases. Hence it is recommended, pragmatically, that the adjusted counts are treated as if they were observed counts, and the confidence intervals calculated using the standard methods.

Attributable fractions

Comparability ratios can be used to adjust numbers of deaths for the calculation of mortality indicators which involve the application of attributable fractions, eg to estimate numbers of smoking-related or alcohol-related deaths. In these cases, the comparability ratios should be used to adjust numbers of deaths separately for each cause, or group of causes, within the definition. Attributable fractions can then be applied to these adjusted numbers. Where the attributable fraction is 1 (eg for causes in which all deaths are accepted as alcohol-related) these can be adjusted as a single group of causes.

When do comparability ratios not need to be applied?

Each comparability ratio has a 95% confidence interval. If the interval includes 1, then the difference in the number of deaths coded to a cause in the old and new versions is not statistically significant. Adjustment is therefore not considered necessary for these deaths.

For causes with very large numbers of deaths, ratios close to 1 may still appear significant but adjusting the mortality rate would have little effect. For example, the comparability ratio for cancers for males over 75 is 1.009, with a confidence interval from 1.004 to 1.014. Adjusting for the impact of the coding change would have little effect on mortality rates for this cause group. It is therefore recommended that deaths are not adjusted where the comparability ratio indicates a change of less than 1%.

The changes to selection rules impact on the selection of the underlying cause of death, but do not affect how causes of death are recorded on the death certificate. For example, the number of deaths where dementia was mentioned on death certificates in 2014 will be comparable to the number mentioned in 2013. No adjustment is therefore needed when using multiple cause of death data to look at mentions of causes.

Reference

Rooney C, Griffiths C and Cook L. The implementation of ICD-10 for cause of death coding – some preliminary results from the bridge coding study. Health Statistics Quarterly 13 (2002): 31-41.

Further resources

Office for National Statistics. Impact of the implementation of IRIS software for ICD-10 cause of death coding on mortality statistics. Statistical Bulletin, 08 August 2014: http://www.ons.gov.uk/ons/rel/subnational-health3/impact-of-the-implementation-of-iris-software-for-icd-10-cause-of-death-coding-on-mortality-statistics/index.html

Baker A, Griffiths C, Fitzpatrick J, Fryers P and Jephson D – Using ONS mortality data – taking account of changes to cause of death coding from 2011: Public Health England, July 2013: http://www.apho.org.uk/resource/view.aspx?RID=132837

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