Results from the ICD–10 v2010 bridge coding study

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The software used by the Office for National Statistics (ONS) for cause of death coding has been updated this year from the International Classification of Diseases, Tenth Revision (ICD–10) v2001.2 to v2010. This bulletin presents the main findings from a bridge coding study of 2009 death registrations (in which deaths were independently coded using v2001.2 and v2010), to help users understand the impact of this change on mortality statistics for England and Wales.

The main changes in ICD–10 v2010 are amendments to the modification tables and selection rules. Modification tables and selection rules are used to ascertain a causal sequence and consistently assign underlying cause of death from the conditions recorded on the death certificate. Overall, the impact of these changes is small although some cause groups are affected more than others.

- There has been a 32 per cent increase in the number of deaths with an underlying cause coded to ‘Mental and Behavioural Disorders’. A large proportion of this increase is caused by a correction to the coding of vascular dementia which was assigned the underlying cause cerebrovascular disease (I67.9) in ICD–10 v2001.2, but is corrected to vascular dementia (F01) in ICD–10 v2010

- The number of deaths with an underlying cause coded to ‘Diseases of the Circulatory System’ has decreased by 5 per cent. This decrease is caused by selection rule changes to cardiomyopathy (I42), heart failure (I50) and cerebrovascular diseases (I60–I69)

- The number of deaths assigned to ‘Diseases of the Genitourinary System’ has decreased by 21 per cent. This decrease is mainly caused by a change to the modification tables allowing a death certificate recording urinary tract infection (N39.0) and dementia (F01 and F03) to assign dementia as the underlying cause

- ‘Diseases of the Respiratory System’ have shown an increase of 2 per cent. Within this group deaths coded with an underlying cause of pneumonia (J18) increased by 8 per cent due to selection rule changes spread across the other groups
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Introduction
In January 2011, the Office for National Statistics (ONS) introduced a new version of the 10th revision of the International Classification of Diseases (ICD–10) used to code cause of death. ICD–10 was introduced in England and Wales in January 2001. Since then amendments have been authorised by the World Health Organisation (WHO) to correct errors in the software supporting the automatic coding or to accommodate new codes in response to new conditions, such as the H1N1 virus (swine flu). Some of these amendments were implemented by ONS manually.

ICD–10 v2010 contains only minor changes to the actual coding classification, with a small number of new codes being added and some original codes having an expanded sub-classification, at the 4th digit level. The main changes are amendments to the modification tables and selection rules used to assign underlying cause of death.

Underlying cause of death is defined by WHO as:
(a) the disease or injury which initiated the train of morbid events leading directly to death, or
(b) the circumstances of the accident or violence which produced the fatal injury

The selection of the underlying cause of death is generally made from the condition or conditions entered in the lowest completed line of Part I of the Medical Certificate of Cause of Death (MCCD). If the certificate has not been completed correctly – for example, if there is more than one cause on a single line with no indication of sequence, or the conditions entered are not an acceptable causal sequence – it becomes necessary to apply one or more of the ICD–10 selection rules. Even when the certificate has been completed properly, there are particular conditions, combinations or circumstances when modification rules are applied to select the correct underlying cause of death.

On some death certificates, for example, it may happen that two or more causes are given that, when linked together, point to another cause (not explicitly mentioned directly on the certificate) as the underlying cause. Also, in some cases the underlying cause of death can be selected from Part II of the death certificate.

Bridge coding study
To understand and quantify the impact of the introduction of ICD–10 v2010 on mortality statistics ONS carried out a bridge coding study in which deaths were independently coded using the ICD–10 introduced in 2001 (ICD–10 v2001.2) and the new ICD–10 version 2010 (ICD–10 v2010). The bridge coding was carried out in a test environment.

There were 491,348 deaths registered in England and Wales in 2009. Of these, 2,251 were neonatal deaths. Neonatal deaths are certified using a perinatal death certificate where underlying cause is not assigned in the usual way. The impact of ICD–10 v2010 on these deaths has been investigated in a separate study.

Inquest deaths are coded manually. Although they were included in the bridge coding study, the coding environment used meant that not all of the information provided by coroners at registration was available for the ONS coders to use when coding the ICD–10 v2010. This means that the
results of the bridge coding for external causes may not be strictly comparable. However ONS expects there to be minimal changes to the underlying causes assigned to this group.

Of the 489,097 records with a coded underlying cause of death, an 11 per cent sample of 55,280 was selected for bridge coding. Comparability ratios with confidence intervals have been calculated using standard methods. Comparability ratios are the ratio of the number of deaths coded to a cause in ICD–10 v2001.2 to the number coded to the equivalent cause in ICD–10 v2010. These ratios reflect the net effect of the change. If the ratio is 1, the number of deaths coded to that cause is the same in both versions. If the comparability ratio is 0.5, half as many deaths have been coded to that cause in ICD–10 v2010 as in ICD–1- v2001.2.

Confidence intervals indicate the reliability of the comparability ratio. Where a comparability ratio is given but its confidence interval includes 1, this means that the difference between the number of death allocated to the cause groups in ICD–10 v2001.2 and ICD–10 v2010 was not statistically significant.

All deaths registered in 2009 were available for sampling. Deaths from 2009 were chosen because this was the most recent published data year available. A random geographically representative cluster sample was taken based on the last digit of the 3-digit registration district code. Within each selected registration district, all records for people aged under 65 years and one in four of the records for people aged 65 years and over were selected, thereby stratifying the sample by age. Approximately equal numbers of records for each of the two strata were coded, to take account of the greater numbers of records for people dying aged 65 and over. Also, people dying at older ages are more often certified as dying from relatively common causes.

Results

Table 1 shows a cross tabulation of deaths from the bridge coding study grouped by chapter in both ICD–10 versions. This is available at:
www.statistics.gov.uk/StatBase/Product.asp?vlnk=15096

The table shows that the vast majority of deaths (around 95 per cent) remained in the same chapters. However there were movements in and out of some chapters reflecting the changes in the selection of underlying cause from the combination of codes given on the death certificate.

I Certain Infections and Parasitic Diseases

Overall the number of deaths assigned to this chapter increased by 9 per cent. The majority of these were previously assigned to ‘Diseases of the Digestive System’. A new code (A09.9) has now been introduced for ‘gastroenteritis and colitis of unspecified origin’, moving deaths from ‘non-infective gastroenteritis and colitis, unspecified’ (K52.9) to the ‘Diseases of the Digestive System’ chapter unless the death certificate specifically mentions that the gastroenteritis or colitis is non-infective.

II Neoplasms

The number of deaths assigned to ‘Neoplasms’ has increased slightly (by 0.5 per cent). The majority of the increase is due to deaths from ‘Diseases of the Circulatory System’ being reassigned following a selection rule change for cerebrovascular diseases (I60–I69). In ICD–10
v2010 cerebrovascular diseases can only be selected as the underlying cause if specific terms are mentioned on the death certificate.

III Diseases of the Blood and Blood-forming Organs and Certain Disorders involving the Immune Mechanism

The number of deaths assigned to this chapter has decreased by 11 per cent. However, in the bridge coded data there are only a small number of deaths with an underlying cause within this chapter, so this percentage is based on few deaths. The reduction is mainly due to the modification tables adding dementia in the valid causal chain when anaemia would previously have been the underlying cause.

IV Endocrine, Nutritional and Metabolic Diseases

The number of deaths assigned to this chapter has decreased by 5 per cent, although this is based on a small number of deaths. Within this chapter deaths coded to hypothyroidism (E039) have decreased by 73 per cent. This is due to a selection rule change stating that hypothyroidism should only be selected as the underlying cause if the words ‘severe’, ‘grave’ or ‘advanced’ are also mentioned.

V Mental and Behavioural Disorders

The number of deaths allocated to ‘Mental and Behavioural Disorders’ has increased by 32 per cent. Of these, over 90 per cent are deaths from dementia (F01 and F03), which were coded to ‘Diseases of the Circulatory System’ (I00–I99) in ICD–10 v2001.2. A high proportion of these were originally coded as cerebrovascular disease (I60–I69), more specifically I67.9 (cerebrovascular disease, unspecified).

Within the dementia cause group there is a large change for vascular dementia (F01), which is a result of a correction implemented in ICD–10 v2010. In ICD–10 v2001.2, vascular dementia deaths were coded as cerebrovascular disease (I60–I69), in particular I67.9 (cerebrovascular disease, unspecified). Also, in ICD–10 v2001.2 a number of dementia deaths were coded as N39.0 (urinary tract infection, site not specified). This change is due to an addition to the modification tables of valid causal sequences.

VI Diseases of the Nervous System

There has been a small decrease of 0.5 per cent of deaths assigned to the ‘Diseases of the Nervous System’ chapter, due to the application of a modified selection rule related to Parkinson's disease (G20) in ICD–10 v2010. There has been a 28 per cent decrease in the number of deaths coded to Parkinson's disease (G20). The majority of these changes are where deaths are now coded to pneumonia, organism unspecified (J18). A smaller number of deaths are now being coded to ‘Circulatory Diseases’ (Chapter IX), and ‘Respiratory Diseases’ (Chapter X). These decreases are slightly offset by some deaths originally coded to unspecified dementia (F03) now being coded to Parkinson's disease in ICD–10 v2010.
VII  Diseases of the Eye and Adnexa, and
VIII  Diseases of the Ear and Mastoid Process

There were no deaths coded to Chapter VII in the sample. All of the six deaths coded to Chapter VIII remained the same. The number of deaths classified to these chapters in the annual mortality statistics is extremely small and ONS expect to see no significant change.

IX  Diseases of the Circulatory System

Diseases of the Circulatory System showed a 5 per cent decrease between ICD–10 v2001.2 and ICD–10 v2010. Within this chapter cardiomyopathy (I42), heart failure (I50), and cerebrovascular diseases (I60–I69) are affected by the selection rule wording changes that mean these conditions will not be picked up as the underlying cause unless other specific terms are also mentioned on the death certificate. The majority of these deaths are now coded to ‘Respiratory Diseases’ (Chapter X) – in particular pneumonia (J18).

X  Diseases of the Respiratory System

Overall this chapter has shown an increase of around 2 per cent between ICD–10 v2001.2 and ICD–10 v2010. In the new version of ICD–10, 8 per cent more deaths are coded to pneumonia (J18). The majority of these deaths were previously coded to cardiomyopathy (I42), heart failure (I50) and Parkinson’s disease (G20). These are selection rule changes. Previously, it would have been assumed that pneumonia could have been caused by heart failure. However, now the rule states that pneumonia can only be caused by heart failure if the heart failure is ‘grave’, ‘severe’ or ‘advanced’. Similar rules also now apply for Parkinson’s disease (G20), acute myocardial infarction (I21.9) and hypothyroidism (E03.9).

A large percentage of the increase that the change to the selection rules had on the number of deaths assigned to this chapter is cancelled out by other changes to the modification tables. Deaths recording a sequence of diseases from bronchopneumonia (J18) to vascular dementia (F01) are now being coded to dementia (F01) as the underlying cause. Also, deaths recording a sequence of diseases from unspecified lower respiratory infection (J22) to a ‘Circulatory Disease’ (Chapter IX) now have a circulatory condition assigned the underlying cause.

XI  Diseases of the Digestive System

‘Diseases of the Digestive System’ showed a small decrease of 2 per cent between ICD–10 v2001.2 and ICD–10 v2010. There were 66 deaths coded to Chapter I ‘Certain Infectious Diseases’ in the new version, because of the new A09.9 code for gastroenteritis. Unless gastroenteritis is specified as being non-infectious, deaths previously coded to K52.9 are now is coded to A09.9.

A further 53 deaths are now coded to external causes. However the majority of these cases are due to the full coroner’s text not being available for bridge coding.

XII  Diseases of the Skin and Subcutaneous Tissue

The number of deaths assigned to this chapter showed a small decrease but this was not significant.
XIII Diseases of the Musculoskeletal System and Connective Tissue

The number of deaths assigned to this chapter showed a small increase but this was not significant.

XIV Diseases of the Genitourinary System

There has been a 21 per cent decrease in the number of deaths coded to the ‘Disease of the Genitourinary System’ chapter (N00–N99). This is the reverse of what happened for dementia. The majority of the decrease is explained by deaths that were previously coded to a disease of the urinary system (N00–N39) (the majority are N39.0, urinary tract infection, site not specified) now being coded to dementia (F01 and F03). A smaller number are now being coded to other ICD–10 chapters including ‘Diseases of the Nervous System’ (Chapter VI) and cerebrovascular diseases (I60–I69).

XV Pregnancy, Childbirth and the Puerperium,

XVI Certain Conditions Originating in the Perinatal Period, and

XVII Congenital Malformations, Deformations and Chromosomal Abnormalities

These chapters have not been fully examined in this report. A substantial number of the deaths from these causes are neonatal. A separate report for neonatal deaths and stillbirth is available on the ONS website.

XVIII Symptoms, Signs and Abnormal Clinical and Laboratory Findings, not elsewhere classified

This chapter showed no change significant change when coded using ICD–10 v2010. Most deaths in this chapter are certified as due to ‘old age’ or ‘senility’, without mention of dementia and with no disease or injury mentioned.

XX External Causes of Injury and Poisoning

Overall, the number of deaths allocated to external causes has increased: however this is not due to the software change but is an artefact of the bridge coding study. This means that the coding of these deaths using both versions of the ICD–10 software is not strictly comparable.

Future work

ONS introduced the new version of the ICD–10 software for all deaths that are registered from January 2011 onwards. Annual mortality statistics for the 2011 data year coded using ICD–10 v2010 are expected to be published in mid 2012. While this bulletin concentrates on the main changes between the chapters of ICD0–10 there are known changes and amendments made in the latest version of ICD-10 that may affect the statistics for specific causes of death. Any impact of these changes will be explained when these statistics are published.
Background Notes

1. A Bridge coding analysis of the impact on stillbirth and neonatal death is also available on the ONS website at: www.statistics.gov.uk/StatBase/Product.asp?vlnk=15309

2. All figures in this bulletin are based on 2009 death registrations data for England and Wales.

3. The death certificate used in England and Wales accords with that recommended by WHO. It is set out in two parts. Part I gives the condition or sequence of conditions leading directly to death, while Part II gives the details of any associated conditions which contributed to the death, but are not part of the causal sequence. An example of the death certificate used in England and Wales is available as an Annex A in the ONS publication Mortality Statistics: Deaths registered in 2009, available on the ONS website at: www.statistics.gov.uk/statbase/Product.asp?vlnk=15096

4. The General Principle for selection of the underlying cause of death states that when more than one condition is entered on the death certificate, the condition entered on the lowest used line of Part I should be selected, but only if it could have given rise to all the conditions entered above it. If this is not the case then the following selection rules are applied:

   Rule 1. If there is a reported sequence terminating in the condition entered first on the death certificate, select the originating cause of this sequence.

   Rule 2. If there is no reported sequence terminating in the condition first entered on the death certificate, select the first-mentioned condition

   Rule 3. If the condition selected by the General Principle, Rule 1 or Rule 2 is obviously a direct consequence of another reported condition (whether in Part I or Part II of the death certificate), select this primary condition

5. The modification tables allow for the identification of valid causal sequences of conditions and give modification rules to improve the usefulness and precision of mortality data. For example, the tables will identify a direct causal sequence between two conditions; however, there are particular conditions, combinations or circumstances when modification rules are then applied to select the correct underlying cause of death. So with some death certificates, two or more causes may be given that, when linked together, point to another cause (not explicitly mentioned directly on the certificate) as the underlying cause.

6. Information on the rules are guidelines adopted by WHO for selection of underlying cause are available in Volume 2 of the ICD-10 manual which is available to download from the WHO at: www.who.int/classifications/icd/en/

7. Details of the policy governing the release of new data are available from the Media Relations Office.

8. National Statistics are produced to high professional standards set out in the Code of Practice for Official Statistics. They undergo regular quality assurance reviews to ensure that they meet customer needs. They are produced free from any political interference.
