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Original Work

A Review of Causes of Mortality in an Acute Medicine of the Elderly and Acute Stroke Service

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ABSTRACT: The information recorded in medical certificates of cause of death (MCCD) can influence population-based mortality and statistical reviews. Data retrieved from MCCD based studies can inform certain aspects of public health planning, health service delivery and evaluation, and could potentially impact health resource allocation. This study retrospectively reviews a total of 173 consecutive MCCD counterfoil records. This included 71 deaths from an acute stroke unit/ward (ASU), and 102 deaths from acute medicine of the elderly (acute MoE) wards of a tertiary referral hospital in a developed country. Disease/condition classification was based upon the International Statistical Classification of Diseases and Related Health Problems (Tenth Revision) (ICD-10, WHO). We describe the top five ICD-10 categories of diseases/conditions documented in Parts 1 and 2 of the MCCD during the study period. We also describe the top five underlying primary medical conditions recorded on the MCCD. A review of some other notable diseases/conditions recorded during the study period is also presented.

KEY WORDS: ***Cause of Death; Death Certificate; ICD-10; Medicine of the Elderly; Mortality; Stroke***

INTRODUCTION

The information detailed in medical certificates of cause of death (MCCD) can prove influential in population-based mortality and statistical reviews.[1] Data arising from MCCD can form the basis for public health planning and service delivery, the latter of which includes health resource allocation.[1] For some adults and older people, an acute admission to hospital occurs on the background of a more complex course of chronic and often multiple co-morbid medical conditions. Post-mortem (PM) examinations are known to improve the accuracy of the death certification process. However, there has been an overall decline in the number of PM examinations carried out in adult age-range patients in the United Kingdom. There are limitations on relying on the accuracy of information recorded on the MCCD for statistical reviews of mortality. Nevertheless, the information on the MCCD is accessible, and when reviewed in context and interpreted with caution, can provide valuable information for public health planning, health service delivery and in health service evaluation.

This study reviews the recorded causes of death in 173 MCCD in an acute medicine of the elderly and an acute stroke service based in a tertiary hospital of a developed country over a specified period.

METHODOLOGY

Relevant Background and Setting

The study was undertaken in an acute medicine of the elderly (acute MoE) service based in the Royal Infirmary of Edinburgh, a teaching (tertiary)

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hospital in Scotland, United Kingdom. At the time of the study, the service offered 104 dedicated beds for acute MoE (82 beds) and acute stroke (22 beds) related care. The acute MoE beds in the hospital are geographically sited across three distinct, but contiguous ward areas comprising of 22, 24 and 36 beds respectively. Patients in the acute MoE beds are mostly in the ≥65 year age-range, although the needs-based admissions policy also provides care for appropriate <65-year-old admissions. The acute stroke unit (ASU) beds accept all 'adult-age range' (notionally ≥16 years in Scotland) acute stroke related referrals.

In our health system, the Part 1 of the MCCD (see appendix) is designed to indicate the immediate cause of death in column 1a. The Part 1 subsections gives allowance to work backwards in a time sequence to the disease(s)/condition(s) that started the process by completing Parts 1b, 1c and 1d respectively, if required.[2]

The Part 2 of the MCCD is designed to indicate other significant diseases, conditions or events that contributed to the occurrence of the death, but were not in themselves part of the primary or main sequence leading to the death. However, Part 2 of the MCCD is not intended to be a comprehensive list all the conditions that were known to be nominally present at the time of death.[2]

Method

As there was no predetermined standard that would classify the study as a clinical audit, the study was tailored towards a 'service evaluation' and involved the non-interventional analysis of anonymised and retrospective data. A retrospective review was conducted on a total of 173 counterfoils of MCCD issued for patients between the period January 2010 and January 2011. The review included 71 consecutive MCCD from the ASU, and a further 102 consecutive MCCD from two of the three acute MoE wards during the study period. The MCCD data from one of the three acute MoE wards could not be retrieved to cover the entire study period, and therefore data from this ward was excluded from the study. An anonymised data collection tool was utilized. The collated data was then sub-categorized with reference to the International Statistical Classification of Diseases and Related Health Problems (Tenth Revision) (ICD-10) coding system.[3] The ICD-10 was applied to aid categorization of the main causes of death. An ICD-10 based approach to coding the data rendered the data more accessible to analysis and interpretation, and also provided a basic epidemiological overview.

The study was observational and descriptive in nature, and as such we did not attempt to verify the accuracy or completeness of any of the certified causes of death as recorded on the MCCD. Consequently, for the purposes of this study we did not access any other supportive or corroborative information from medical records, laboratory tests, radiological tests or post-mortem/autopsy examination results other than what was explicitly recorded on the MCCD. The study of the MCCD counterfoils did not involve collection of the gender of the deceased, or details of the certifying doctor.

Where cases were discussed with the Procurator Fiscal's (PF) office and permission thereafter granted to the referring/reporting doctor to proceed with issuing the MCCD; then the MCCD was included in the data collation for this study.

However, in cases where a referral had been made to the PF's office and the case subsequently taken over for further investigation, the standard practice in our setting is that the certifying/reporting doctor would not have completed the MCCD. In the latter scenario, the MCCD would usually be subsequently completed by a PF appointed Pathologist/Doctor with our service. Consequently, no PF-referred cases that were subsequently taken over for further investigation by the PF's office were included in this study.

RESULT

Results were obtained from a total of 173 consecutive MCCD counterfoil records. This included 71 deaths from the ASU, and 102 deaths from the acute MoE wards.

Disease Categories in Part 1 of the MCCD

When the ASU and acute MoE wards were analyzed jointly (based on the ICD-10 system that we adopted), the five most common categories that were recorded in Part 1 (in any of subsections 1a through to 1d) of the MCCD are presented in **Figure 1**.

For clarity, the category of 'Diseases of the Circulatory System' in the ICD-10 includes the subcategories of 'Ischemic Heart Diseases', 'Other forms of Heart Diseases' and 'Cerebrovascular Diseases'. Part 1 MCCD data from the ASU and acute MoE wards were also analyzed separately. For the ASU only, the five most common ICD-10 categories that were recorded in Part 1 (in any of subsections 1a to 1d) of the MCCD are presented in **Figure 2**.

For the acute MoE wards only, the five most common ICD-10 categories recorded in Part 1 (in any of subsections 1a to 1d) of the MCCD are presented in **Figure 3**.

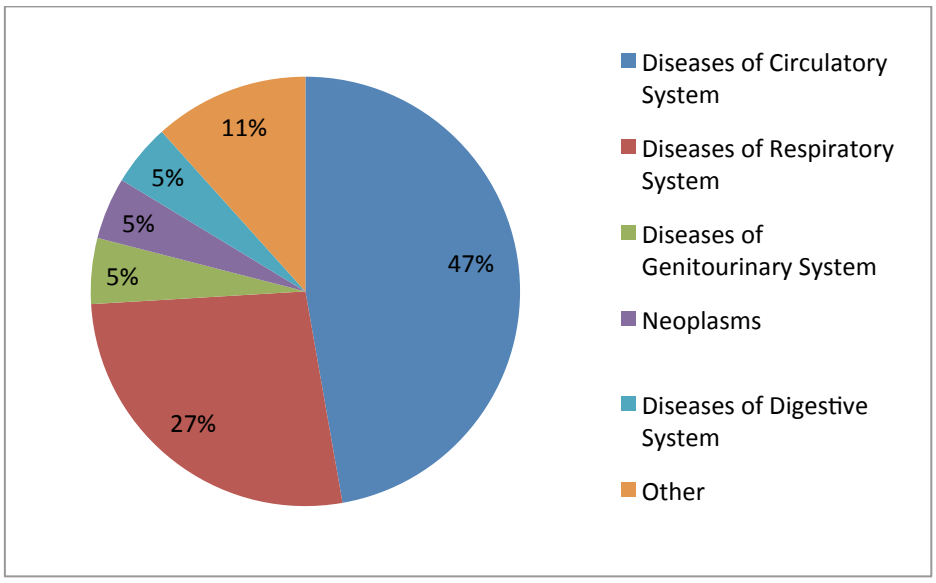

Figure 1: Pie Chart representing Parts 1a to 1d of the MCCD from the ASU and Acute MoE Wards (combined)

Key to Figure 1:

Diseases of Circulatory System	162
Diseases of Respiratory System	92
Diseases of Genitourinary System	17
Neoplasms	16
Diseases of Digestive System	16
Other	40
Total	343

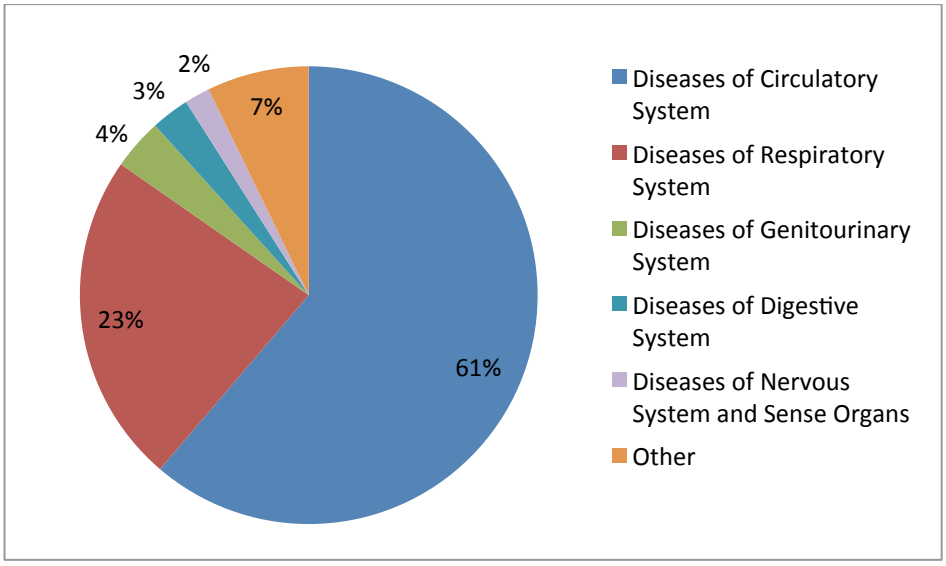

Figure 2: Pie Chart representing Parts 1a to 1d of the MCCD from the Acute Stroke Unit

Key to Figure 2:

Diseases of Circulatory System	68
Diseases of Respiratory System	26
Diseases of Genitourinary System	4
Diseases of Digestive System	3
Diseases of Nervous System and Sense Organs	2
Other	8

Total	111

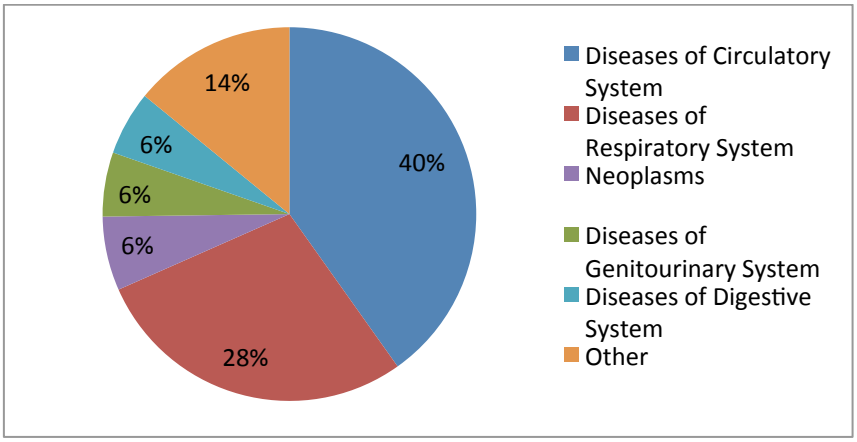

Figure 3: Pie Chart representing Parts 1a to 1d of the MCCD from the Acute MoE wards

Key to Figure 3:

Diseases of Circulatory System	94
Diseases of Respiratory System	66
Neoplasms	15
Diseases of Genitourinary System	13
Diseases of Digestive System	13
Other	33
Total	234

Disease Categories in Part 2 of the MCCD

When the ASU and acute MoE wards were analyzed jointly, the five most common ICD-10 categories recorded in Part 2 of the MCCD are presented in **Figure 4**.

Part 2 data from the ASU and acute MoE wards were also analyzed separately. For the ASU only, the five most common ICD-10 categories recorded in Part 2 of the MCCD are presented in **Figure 5**.
For the acute MoE wards only, the five most common ICD-10 categories recorded in Part 2 of the MCCD are presented in **Figure 6**.

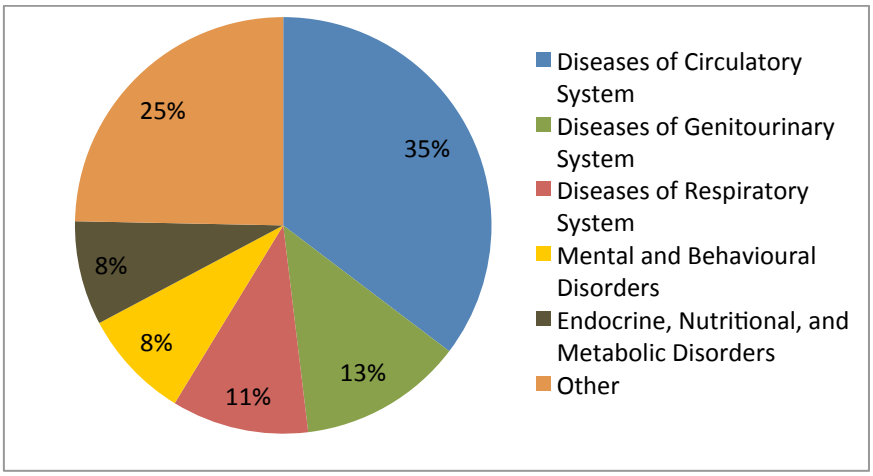

Figure 4: Pie Chart representing Part 2 of the MCCD from the ASU and Acute MoE Wards (combined)

Key to Figure 4:

Diseases of Circulatory System	83
Diseases of Genitourinary System	30
Diseases of Respiratory System	25
Mental and Behavioural Disorders	20
Endocrine, Nutritional, and Metabolic Disorders	19
Other	58

Total	235

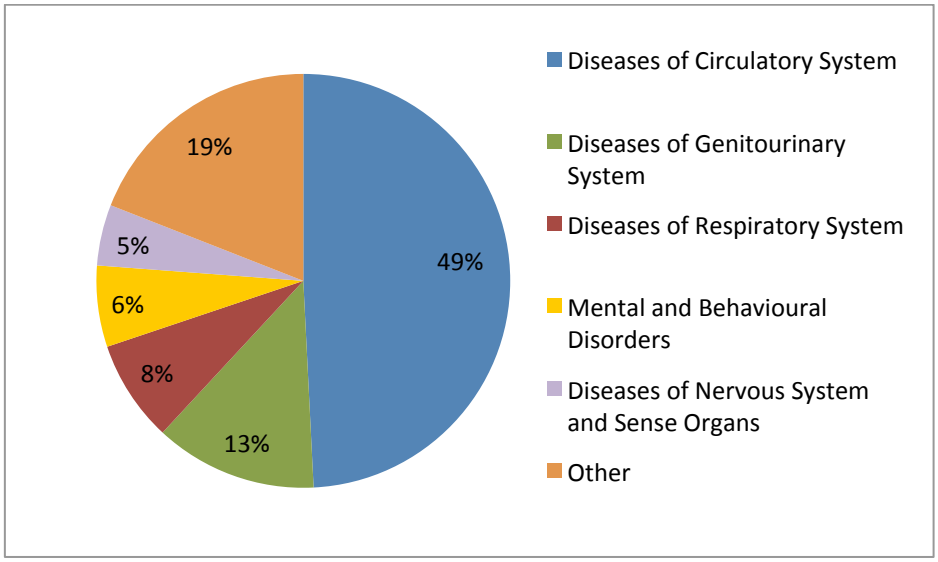

Figure 5: Pie Chart representing Part 2 of the MCCD from the Acute Stroke Unit

Key to Figure 5:

Diseases of Circulatory System	31
Diseases of Genitourinary System	8
Diseases of Respiratory System	5
Mental and Behavioural Disorders	4
Diseases of Nervous System and Sense Organs	3
Other	12
Total	63

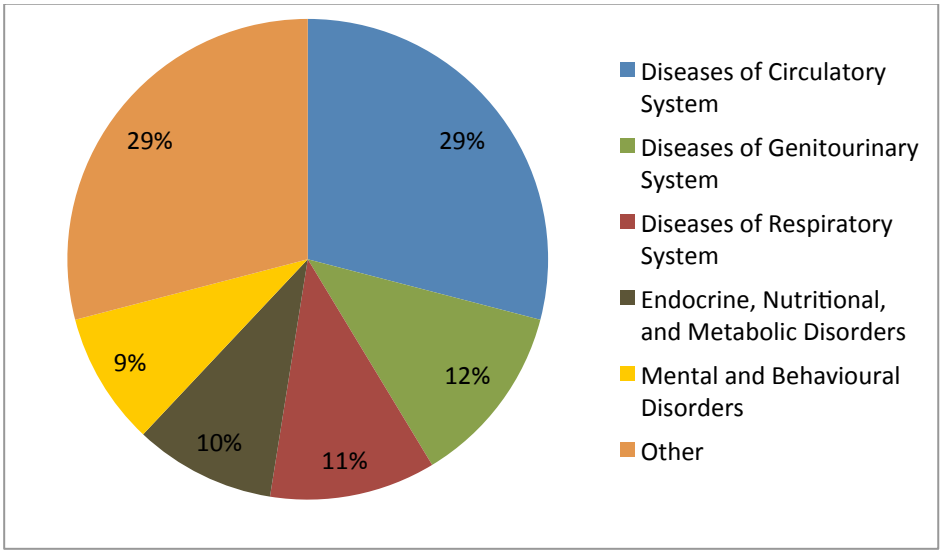

Figure 6: Pie Chart representing Part 2 of the MCCD from the Acute MoE wards

Key to Figure 6:

Diseases of Circulatory System	52
Diseases of Genitourinary System	22
Diseases of Respiratory System	20
Endocrine, Nutritional, and Metabolic Disorders	17
Mental and Behavioural Disorders	16
Other	52
Total	179

The Five Most Common underlying Primary Medical Conditions recorded on the MCCD on the ASU

The most commonly recorded underlying primary condition resulting in death, as recorded in Part 1 (inclusive of subsections 1a to 1d) of the MCCD on the ASU, was unsurprisingly attributed to underlying 'Acute Stroke or Cerebrovascular Disease related events' in 45 entries representing 40.5% of the total (**Figure 7**). These were variably described as 'Ischaemic Strokes'/'Cerebral Infarction' (35 entries; 32%), or as 'Hemorrhagic Strokes'/'Intracerebral Hemorrhage' (7 entries; 6%),' or 'Subarachnoid Hemorrhage' (1 entry; 1%), and a further 2 unclassified entries of 'Acute Stroke'.

The second most commonly recorded underlying primary condition resulting in death, as recorded in the Part 1a to 1d of the MCCD in the ASU, was attributed to 'Lower Respiratory Tract Infection related events' in 24 entries representing 22% of the total (**Figure 7**). These were variably described as 'Bronchopneumonia' (15 entries; 14%), 'Aspiration Pneumonia' (7 entries; 6%), 'Lower Respiratory Tract Infection' - LRTI (1 entry; 1%) and 'Hospital Acquired Pneumonia' (1 entry; 1%).

The third most commonly recorded underlying primary condition resulting in death, as recorded in the Part 1a to 1d of the MCCD in the ASU, was attributed to 'Ischaemic Heart Disease – IHD related events' in 10 entries representing 9% of the total (**Figure 7**). Two IHD-related entries (2%) were not classified further, but the other eight IHD-related events were further described as either 'Congestive Cardiac Failure – CCF/Left Ventricular Failure – LVF/Left Ventricular Systolic Dysfunction – LVSD' (5 entries; 5%), or as 'Acute Coronary Syndrome – ACS/Myocardial Infarction – MI' (3 entries; 3%).

Figure 7 also indicates the fourth most common ('Acute Kidney Injury related events' i.e. in 4% of the total), and the fifth most common ('Pulmonary Embolism related events' i.e. in 3% of the total) underlying primary conditions recorded in Part 1a to 1d of the MCCD on the ASU.

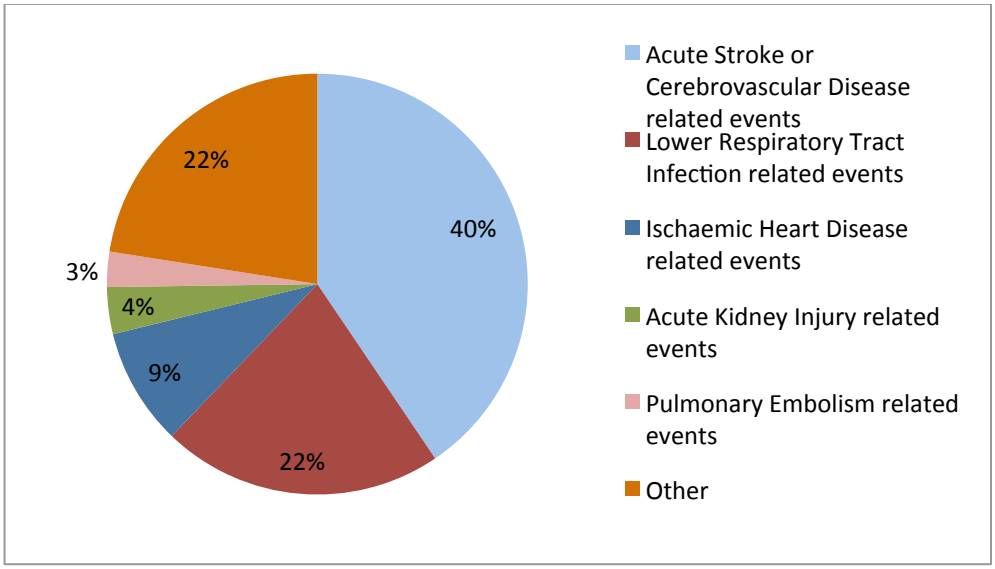

Figure 7: Pie Chart representing the five commonest underlying 'Primary' Medical Conditions recorded in Parts 1a to 1d of the MCCD from the Acute Stroke Unit

Key to Figure 7:

Acute Stroke or Cerebrovascular Disease related events	45
Lower Respiratory Tract Infection related events	24
Ischaemic Heart Disease related events	10
Acute Kidney Injury related events	4
Pulmonary Embolism related events	3
Other	25
Total	111

The Five Most Common underlying Primary Medical Conditions recorded on the MCCD on the Acute MoE wards

The most commonly recorded underlying primary condition resulting in death, as recorded in Part 1 (inclusive of subsections 1a to 1d) of the MCCD on the acute MoE wards, were attributed to 'Ischaemic Heart Disease - IHD or complications arising therefrom' in 48 entries and representing 21% of the total (**Figure 8**). Nineteen IHD-related entries (8%) were not classified further, but the other IHD-

related events were further described as 'Congestive Cardiac Failure – CCF/Left Ventricular Failure – LVF/Left Ventricular Systolic Dysfunction – LVSD' (18 entries; 8%), or as 'Acute Coronary Syndrome – ACS/Myocardial Infarction – MI' (11 entries; 5%).

It is noteworthy that, in accordance with UK practice, where a descriptive mode of death such as 'Heart Failure' would not be deemed acceptable as a stand-alone entry on the MCCD (that is without clarifying a further underlying causative diagnosis/condition), the entries with 'Heart Failure' or variations thereof had been further characterized in subsections Part 1b onwards, with an underlying medical condition e.g. 'Ischemic Heart disease', 'Valvular Heart Disease', etc.

The second most commonly recorded underlying primary condition resulting in death, as recorded in the Part 1a to 1d of the MCCD in the acute MoE wards was attributed to 'Lower Respiratory Tract Infection related events' in 40 entries representing 17% of the total (**Figure 8**). These were variably described as 'Bronchopneumonia' (32 entries; 14%), 'Aspiration Pneumonia' (7 entries; 3%), and 'Lower Respiratory Tract Infection' (1 entry; 0.4%).

The third most commonly recorded underlying primary condition resulting in death, as recorded in the Part 1a to 1d of the MCCD in the acute MoE wards were attributed to underlying 'Acute Stroke or Cerebrovascular Disease related events' in 22 entries representing 9% (**Figure 8**). These were variably described as 'Ischaemic Strokes'/'Cerebral Infarction' (14 entries; 6%), or as 'Hemorrhagic Strokes'/'Intracerebral Hemorrhage' (4 entries; 2%),' and a further 4 (2%) unclassified entries of 'Cerebrovascular Disease'.

Figure 8 also indicates the fourth most common ('Neoplasms/Malignancy related events' i.e. in 7% of the total), and the fifth most common ('Chronic Obstructive Pulmonary Disease - COPD related events' i.e. in 4% of the total) underlying primary conditions recorded in Part 1a to 1d of the MCCD on the acute MoE wards.

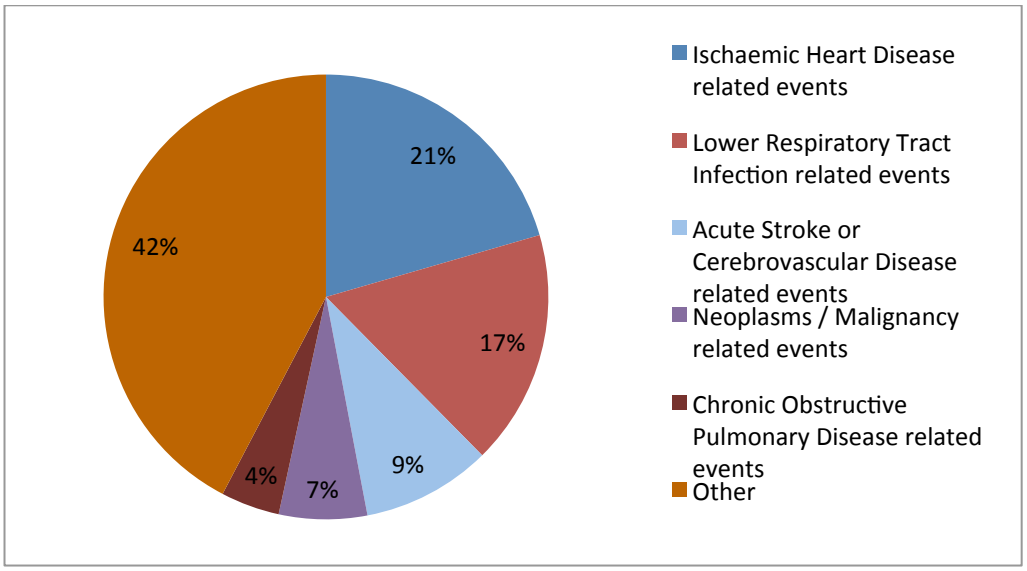

Figure 8: Pie Chart representing the five commonest underlying 'Primary' Medical Conditions recorded in Parts 1a to 1d of the MCCD from the Acute MoE wards

Key to Figure 8:

Ischaemic Heart Disease related events	48
Lower Respiratory Tract Infection related events	40
Acute Stroke or Cerebrovascular Disease related events	22
Neoplasms / Malignancy related events	15
Chronic Obstructive Pulmonary Disease related events	10
Others	99
Total	234

Results of Some Other Notable underlying Conditions recorded in the MCCD on the ASU and Acute MoE wards

In this study, a total of 23 entries of various 'Neoplasms/Malignancy' were recorded as either a primary or secondary cause of death across both the ASU and acute MoE wards. Of these, the recorded primary site of the malignancy was identified as lung (7 entries), pancreatic (3), haematological or multiple myeloma (3), unconfirmed primary with metastatic disease (2), cholangiocarcinoma (2), urinary bladder (2), breast (1), prostate (1), renal (1), and oesophageal (1).

'Diabetes Mellitus (DM) and/or its related complications' (hyperosmolar state, vasculopathy, ulcers, nephropathy, etc.) were recorded as a contributory primary cause of death in 5 patients, all of whom were on the acute MoE wards. The corresponding figure for DM when recorded as a contributory secondary cause of death was noted in 16 patients, with 2 entries on the ASU and 14 entries on the acute MoE wards. Other notable endocrine conditions recorded as a primary or secondary contributory causes of death were 'Addison's Disease' or 'Adrenocortical Insufficiency'/'Hypoadrenalism' (2 entries) and 'Hypothyroidism' (1 entry).

'Dementia' (either further subcategorized or not) was recorded as a contributory primary or secondary cause of death in a total of 21 entries across both the ASU and acute MoE wards. Three entries indicated 'Vascular Dementia' with 1 entry (0.3%) in Part 1 of the MCCD and 2 entries (1%) in Part 2 of the MCCD respectively. Four entries (2%) reflected 'Alzheimer's Dementia', with all of these noted in the Part 2 of the MCCD. Two entries documented 'Parkinson's Disease Associated Dementia' with 1 entry (0.3%) in Part 1 of the MCCD and 1 entry (1%) in Part 2 of the MCCD respectively. There was a subtotal of 12 entries in which the Dementia was not classified further (i.e. 'Unspecified Dementia'): Part 1 of MCCD had 3 such entries (1%), and Part 2 of the MCCD had 9 such entries (4%).

A further solitary case (1%) on an acute MoE ward had been recorded as 'Cognitive Impairment' on the Part 2 of the MCCD, and was therefore not included in the earlier quoted total figures for the 'Dementia' related causes.

'Delirium' was reflected as contributory to secondary cause of death in 6 cases (3.4%), all of whom were on the acute MoE wards.

Although not noted to have a specific ICD-10 code, the term 'Frailty' was nevertheless noted to have been documented as contributory to the primary or secondary cause of death in a total of 12 cases, with 2 entries on the ASU and 10 entries on acute MoE wards. Overall, the use of the term 'Frailty' was documented as contributory to the primary cause of death in 3 MCCDs (i.e. 1% of 343 entries across both the ASU and acute MoE wards), and as contributory to secondary cause of death in 9 MCCDs (i.e. 4% of 235 entries across both the ASU and acute MoE wards).

'Reduced Mobility' or 'Immobility' (considered as abnormalities of gait and mobility in ICD-10) were listed as an associated primary cause of death in 9 cases (i.e. 1% of 343 entries in the Part 1 of the MCCD), with 2 entries on the ASU and 7 entries on the acute MoE wards. No cases of immobility were noted to have been recorded as a secondary cause of death on the MCCDs during the study period.

'Acute Pulmonary Embolism' was recorded as either a primary or secondary cause of death in a total of 9 cases (2.6% of all entries). This comprised of 3 entries (2.7% of 111 entries) on the ASU, and 6 entries (2.6% of 234 entries) on the acute MoE wards.

'Falls', which could be more clearly categorized as 'external causes of accidental injury' (based on ICD-10) were recorded as contributory to secondary cause of death in 2 patients on the acute MoE wards.

In this study, a specifically named organism (e.g. *Escherichia coli*, *Staphylococcus aureus*, etc.), or a recognized Healthcare Associated Infection – HCAI/HAI (e.g. methicillin resistant *Staphylococcus aureus* – MRSA, *Clostridium difficile* infection, etc.) was recorded as a contributory primary or secondary cause of death in a total of 7 entries across both the ASU and acute MoE wards.

In this study, there were no recorded MCCD entries of death related to human immunodeficiency virus (HIV) related infection and/or its associated complications.

DISCUSSION

This study was undertaken to provide an insight into the commoner causes of death that are recorded in the MCCD for patients in an acute stroke ward/unit (ASU) and acute medicine of the elderly (MoE) wards based in a tertiary hospital setting of a developed country.

Using the ICD-10 classification, we identified the five most common disease categories recorded in either Part 1 or Part 2 of the MCCD in our service over the study period.

It is noteworthy that based on the ICD-10, the category of 'Diseases of the Circulatory System' ranked highest amongst both the primary and secondary contributory causes of death. This category of 'Diseases of the Circulatory System' was commonest whether or not the data from the wards were analyzed jointly or separately. As clarified earlier, the ICD-10 category of 'Diseases of the Circulatory System' includes the subcategories of 'Ischaemic Heart Diseases', 'other forms of Heart Diseases' and also 'Cerebrovascular Diseases'.

This study also identified the five most common underlying primary medical diseases/conditions that were recorded as causing deaths in our ASU and acute MOE wards. Unsurprisingly, on the ASU, the commonest recorded underlying primary condition resulting in death, as recorded in Part 1a to 1d of the MCCD, was 'Acute Stroke or Cerebrovascular Disease related events or complications arising therefrom.' By comparison, on the acute MoE wards the commonest recorded underlying primary condition resulting in death, as

recorded in Part 1a to 1d of the MCCD, was 'Ischaemic Heart Disease or complications arising therefrom.'

Some limitations that we identify from this study include: (1) Its observational and descriptive nature, (2) its retrospective nature, (3) the potential for sampling bias and sampling error as data from only two of the three acute MoE wards were retrievable, collated and reviewed for the MoE related component of the study, (4) the comparatively modest numbers included in the study, and, (5) the fact that the study was not designed to attempt to verify the accuracy or completeness of any of the certified causes of death recorded on the counterfoils of the MCCD.

Some earlier studies have indicated concerns over a potential lack of completeness in the MCCD, and also raised the possibility of the presence of general inaccuracies in the completion of the MCCD.[4-7]

Some targeted educational interventions have been described previously that could impact positively upon the completeness and accuracy of MCCD. However, such improvements were noted to vary dependent on the type and nature of the intervention.[1,8-10]

MCCD reports might not concord consistently with post-mortem/autopsy examination results.[11-17] Post-mortem examinations are known to improve the accuracy of the death certification process.[11-17] Nevertheless, there has been an overall and progressive decline in the number of post-mortem examinations carried out in adult age-range patients in the United Kingdom. Therefore, and despite the identified limitations of MCCD based mortality statistics, the results of this study still provide additional information into the causes of death that are commonly recorded on completed MCCD on an ASU and on acute MoE wards of a large tertiary hospital in a developed country.

In the absence of corroborating post-mortem based data and other relevant supporting data, one can contend that a completed MCCD merely reflects the cause of death as perceived by the various clinical teams with responsibility for a patient's care. Furthermore, it could be hypothesized that there is a subjective element to the process, and that this could potentially influence the accuracy of information contained in a MCCD.[7]

It is possible that certain clinical conditions were under-represented/under-reported/under-diagnosed, or indeed over-represented/over-reported/over-diagnosed in this study.[16,18] Therefore, in general it would be advantageous to make reference to relevant 'population-specific' statistics when attempting to interpret data retrieved from MCCD based studies.[2] It is also appropriate, where available, to make reference to 'age-standardised' death rates (e.g. 'Under 75 years' versus 'Over 75 years' comparators), and to take cognisance of other influences such as 'year-to-year fluctuations', 'gender influences', 'data zone population densities', 'data on place of death/occurrence' etc.[2]

For example, in Scotland where our study was conducted, the commoner ICD-10 categories of causes of death in the 'over 65 year', and also in the 'over 75 year' age sub-categories in the calendar years 2010 and 2011, were predominantly 'Diseases of the Circulatory System' (mainly 'Ischaemic Heart Disease' and 'Cerebrovascular Disease'), followed by 'Neoplasms/Malignancies', and then by 'Diseases of the Respiratory System (mainly 'Pneumonia' and 'Chronic Lower Respiratory Diseases' such as COPD). The findings of this study also demonstrated common rates of occurrence of ICD-10 categories of death arising from both 'Diseases of the Circulatory System' and 'Diseases of the Respiratory System', and this is generally consistent with the broader Scottish national population-related data. However, in our study, the deaths attributable to underlying 'Neoplasms' appeared to be comparatively lower than would be expected, i.e. in contrast to the Scottish national data. This finding might be partly explained by the fact that our study was based at one acute hospital site (the New Royal Infirmary of Edinburgh), whereas the Specialist Oncology Centre for our region is situated at another acute hospital site (the Western General Hospital, Edinburgh). Therefore, admissions for predominantly cancer-related care needs might have been selectively triaged to the specialist oncology hospital site, or patients could have been transferred across sites if further inpatient assessment and/or care were deemed clinically appropriate. Many patients with cancer show a progressive, rather than an abrupt terminal illness trajectory, and could have opted for the provision of end-of-life care in their own homes or in a hospice, rather than in an acute hospital setting; in which case there might conceivably have been under-representation of the neoplasm-related care subgroup in our study.

Another interesting point noted from this study is the suggestion that the concept of 'frailty' is gaining increasing recognition. This is particularly relevant to the clinical specialty of geriatric medicine. Despite this increasing recognition, it has however proven historically more elusive to achieve what can be termed 'a universally accepted definition for frailty'. Over the years, some definitions of 'frailty' have placed emphasis on the complex interplay of factors (e.g. physiological, medical, but occasionally also environmental and social) and the potential for these various factors to impair the ability of an individual to respond to stressors. Consequently, an illness that would otherwise result in a reversible impairment in a reasonably fit person could potentially translate into a more permanent disability in a frail person.[19]

There have been continuing efforts and clinical

studies designed to aid the identification, quantification and even phenotypic characterisation of the 'frailty construct', as well as debates on what other specific factors and/or determinants (e.g. cognition) should be included in its definition/description.

In this study, we noted that the term 'frailty' was specifically employed in a total of 1% of the Part 1 entries, and in a total of 4% of the Part 2 entries of the MCCDs across both the ASU and acute MoE wards. This raises an important question, as to whether or not current clinical practice has evolved to the point of recognizing 'frailty' as a formal clinical condition, or even possibly whether it is being considered by some as an acceptable formal clinical diagnosis.

Although 'frailty' currently does not have a specific ICD-10 code, some aspects/elements of the concept of 'frailty' can be identified in other coding subcategories within the ICD-10 (e.g. 'asthenia', 'debility'). However, another question currently before us is whether or not 'frailty' now deserves, in its own right, the assignment of a specific ICD-10 code or sub-code. Our study findings raise the question of whether or not the use of the term 'frailty' in death certification would be identified in other clinical specialties, in other hospitals/centres, and indeed in other countries, if similar MCCD-based studies were conducted in other areas. If so, then it is equally plausible that the use of the term 'frailty' is going to feature progressively more in the future in death certification by clinicians in the field of geriatric medicine, and/or indeed in other clinical specialties that care for older patients. We postulate that this is particularly the case as clinical practitioners increasingly recognize both the existence of 'frailty', and also as they ascribe added clinical weighting to its impact in the end of life care of patients.[20]

Another thought-provoking question under consideration relates to the significance of including 'dementia' and 'delirium' in death certification. Both conditions are currently assigned codes in the ICD-10, but as this study was based in a dedicated geriatric medicine service, we could not ascertain if the incorporation of these specific conditions (which are individually noted to be conditions of high prevalence in medicine of the elderly wards) on the reviewed MCCDs would have been reproduced at comparable rates if the study had been conducted in other clinical specialties like General (Internal) Medicine or Intensive Care Medicine. In the wider field of clinical medicine, and even within the specialist field of geriatric medicine, some clinicians would take the view that many patients 'die with a dementia' rather than 'die due to, or of a dementia'. Within the ICD-10 coding guidance, there is however scope for 'dementia' to be treated as a predisposing condition in the sequence of cause of death. For example, a hypothetical MCCD could read 'Aspiration Pneumonia' due to 'Neurogenic Dysphagia' due to 'Alzheimer's Disease.' Alternatively, another hypothetically MCCD could read 'Bronchopneumonia' due to 'Immobility', due to 'Advanced Dementia in association with Parkinson's disease'.

This study also raises the question of whether or not it is possible that certain factors (e.g. the clinical specialty of an individual clinician), could potentially modify one's views on whether or not a condition such as 'Advanced Dementia' would be deemed sufficient as a sole cause of death on a MCCD or not. Arguably a similar question could be put forward for deaths arising in association with certain cancers e.g. is it the advanced nature of a (hypothetical) prostate cancer that was the cause of death; or was it the complicated urinary tract infection (e.g. associated with a degree of prostatic obstructive uropathy) that was being treated concurrently at the time of the (hypothetical) patient's death?

The relatively short timeline of this study is unlikely to have detected any emerging or changing trends in our mortality statistics. Longitudinally based studies would be required to identify and study any evolving trends in mortality.[21] As discussed earlier, this study was not designed to study the accuracy of the death certification process, but the findings of our study have generated some interesting questions that could form the basis for future research based studies.

CONCLUSION

The information contained in MCCDs can play important roles in public health service planning, delivery and evaluation. This study contributes to the medical literature by reviewing MCCD-retrieved data for two specified patient groups i.e. from an acute stroke unit and from acute medicine of the elderly wards of a tertiary hospital in a developed country. We have raised some pertinent questions that could form the basis for future research based studies on MCCDs such as: ascertaining the accuracy of MCCD related data[22], and a need to identify factors that could potentially influence MCCD completion patterns. We have also highlighted a need for cautious interpretation of MCCD-retrieved data, making due reference to relevant study populations. The use of the ICD-10 allows for easier reproducibility of the study methodology, by cross-referencing to an internationally defined classification system.

REFERENCES

1. Myers KA, Farquhar DR. Improving the accuracy of death certification. *CMAJ*. 1998;158(10):1317-23.

2. National Records of Scotland (NRS); formerly the General Register Office for Scotland (GROS). Retrived from: http://www.gro-scotland.gov.uk/ Last accessed on 10th March 2012.
3. International Statistical Classification of Diseases and Related Health Problems (Tenth Revision) (ICD-10). World Health Organization. Retrived from: http://www.who.int/classifications/icd/en/ Last accessed on 27th March 2012.
4. Slater DN. Certifying the cause of death: an audit of wording inaccuracies. *J Clin Pathol*. 1993;46(3):232-4.
5. Swift B, West K. Death certification: an audit of practice entering the 21st century. *J Clin Pathol*. 2002;55(4):275-9.
6. Pritt BS, Hardin NJ, Richmond JA, Shapiro SL. Death certification errors at an academic institution. *Arch Pathol Lab Med*. 2005;129(11):1476-9.
7. Tuffin R, Quinn A, Ali F, Cramp P. A review of the accuracy of death certification on the intensive care unit and the proposed reforms to the Coroner's system. *JICS*. 2009;10(2):134-7.
8. Selinger CP, Ellis RA, Harrington MG. A good death certificate: improved performance by simple educational measures. *Postgrad Med J*. 2007;83(978):285-6.
9. Pandya H, Bose N, Shah R, Chaudhury N, et al. Educational intervention to improve death certification at a teaching hospital. *Natl Med J India*. 2009;22(6):317-9.
10. Aung E, Rao C, Walker S. Teaching cause-of-death certification: lessons from international experience. *Postgrad Med J*. 2010;86(1013):143-52.
11. McKelvie PA. Medical certification of causes of death in an Australian metropolitan hospital. Comparison with autopsy findings and a critical review. *Med J Aust*. 1993;158(12):816-8, 820-1.
12. Sington JD, Cottrell BJ. Analysis of the sensitivity of death certificates in 440 hospital deaths: a comparison with necropsy findings. *J Clin Pathol*. 2002:55(7):499-502.
13. Ravakhah K. Death certificates are not reliable: revivification of the autopsy. *South Med J*. 2006;99(7):728-33.
14. Gibson TN, Char G. Causes of death at autopsy in hospitalized adult patients with diabetes mellitus: a study from a developing country. *The Internet J Pathol*. 2007;6(1): Retrieved from http://ispub.com/IJPA/6/1/9901. Last accessed on 27th March 2012.
15. Papazafiropoulou A, Tentolouris N, Bousboulas S, Sotiropoulos A, et al. In-hospital mortality in a tertiary referral hospital: causes of death and comparison between patients with and without diabetes. *Exp Clin Endocrinol Diabetes*. 2010;118(5):315-9.
16. Gibson TN, Shirley SE, Escoffery CT, Reid M. Discrepancies between clinical and post-mortem diagnoses in Jamaica: an evaluation of clinical over diagnoses. *The Internet J Pathol*.. 2007;6(2): Retrieved from: http://ispub.com/IJPA/6/2/5593. Last accessed on 28th March 2012.
17. Gibson TN, Shirley SE, Escoffery CT, Reid M. Discrepancies between clinical and post-mortem diagnoses in Jamaica: A study from the University Hospital of the West Indies. *J Clin Pathol*. 2004;57(9):980-5.
18. Tariq M, Jafri W, Ansari T, Awan S, et al. Medical mortality in Pakistan: experience at a tertiary care hospital. *Postgrad Med J*. 2009;85(1007):470-4.
19. Rockwood K, Fox RA, Stolee P, Robertson D, et al. Frailty in elderly people: an evolving concept. *CMAJ*. 1994;150(4):489-95.
20. Rockwood K, Mitnitski A. Frailty defined by deficit accumulation and geriatric medicine defined by frailty. *Clin Geriatr Med*. 2011;27(1):17-26.
21. Goel N, Bhatia S, Abrol A, Bhatnagar T, et al. Changing mortality trends in Chandigarh, India. *The Internet J Epidemiol*. 2007;5(1): Retrieved from: http://ispub.com/IJE/5/1/11448. Last accessed on 27th March 2012.
22. Srivastava PC, Saxena S, Sahai MKB. Medical Certification of cause of death. *Internet J Medical Update*. 2009;4(1):56-8. Retrieved from: http://www.akspublication.com/letter01_jan2009_.pdf