

# Death certification and the epidemiologist

Tim Devis and Cleo Rooney,  
ONS

## INTRODUCTION

In England and Wales the modern system of birth and death registration has its origins in an act of parliament which came into force in 1837.<sup>2</sup> This provided the basis for a national registration system, directed by a General Register Office headed by the Registrar General. However, as originally presented to parliament in 1836 the Registration Bill did not include a provision to record the cause of death when a death was entered in the register. Following pressure from the reformer Edwin Chadwick and others for its inclusion, the Bill was amended and later passed with this requirement included. Chadwick's interests extended beyond the legal and administrative advantages of a uniform system to the insight such information could give into social conditions and public health problems. As a result the Registrar General has been able to collect and publish mortality information by cause of death since the Act came into operation.<sup>3,4</sup>

The first Registrar General, Thomas Lister, was quick to enlist the co-operation of the medical profession in making the statements of cause of death as accurate as possible. At his invitation the heads of various medical colleges pledged themselves and their members to give an authentic name to the conditions leading to death, when completing the registration. Lister entrusted the work of analysing and developing these new data sources to his medical statistician William Farr, who in the next 40 years was outstanding in exploiting and expanding the use of the data, particularly in providing evidence of the effects of insanitary and unhealthy conditions. Farr was also a prime mover in securing recognition of the importance of scientific nomenclature and scientific classification in medical statistics, initiating a nosology which culminated in an internationally agreed classification of diseases, injuries and causes of death. The general

**The various processes by which deaths are certified and registered by doctors and coroners, are of considerable interest to the epidemiologist studying mortality trends and patterns. This paper describes and discusses these processes in England and Wales, some dating from the nineteenth century, and illustrates in particular the importance of accurately recording the causes of deaths. It also updates an earlier article on this subject<sup>1</sup> and takes account of the many changes affecting registration and certification in recent years.**

arrangement of diseases by anatomical site was proposed by him in 1855, and has survived as the basis of the International Classification of Diseases (ICD), first adopted in 1900. The Ninth Revision of ICD<sup>5</sup> (ICD9) is currently used by ONS to classify causes of death. The Tenth Revision is already in use in several other countries, and will be introduced in 2001 in England and Wales. However, it was introduced for morbidity coding in the National Health Service in 1995.

The subsequent Births and Deaths Registration Act of 1874, which made death registration compulsory, also placed a specific duty on the medical practitioner who attended the deceased during the last illness to provide a statement of the cause of death, unless there was an inquest – this act involved coroners for the first time.

A further advance followed in the Birth and Death Registration Act 1926, which compelled medical practitioners to use a standard printed form for certifying the causes of death. Up to this time the form in use distinguished ‘primary’ and ‘secondary’ causes of death, often making it difficult to say which cause was a consequence of another.<sup>6</sup> From 1927 certifiers were required to give in sequential order the medical conditions leading to death, as discussed later in this paper. Another act of 1926 made provision for coroners to distinguish between post-mortem examinations which accompanied inquests and those where no inquest was held.

The power to hold a post-mortem<sup>7</sup> and then dispense with an inquest was also introduced. Statistics on this aspect of registration have thus been available only since 1928.

More recently, the Registration Service Act of 1953 consolidated earlier provisions covering the organisation of the registration service, while the Births and Deaths Registration Act of the same year covered the registration of births, stillbirths and deaths. Two Population Statistics Acts, of 1938 and 1960, made provision *inter alia* for certain information to be collected in confidence and not entered in the public record; these details may be used by the Registrar General only for statistical purposes, and may not be released under any circumstances.<sup>8</sup> For deaths, this information at present includes the marital status of the deceased, and the age of the surviving spouse (if any) of the deceased.

**RECENT DEVELOPMENTS**

Earlier this decade ONS (then the Office of Population Censuses and Surveys (OPCS)) carried out an extensive redevelopment of its collection and processing systems for population, health, and registration data – in particular, for births and deaths. For deaths this included: the progressive computerisation of registration in local offices; the move to a large deaths database to hold all mortality data from 1993; and the introduction of automated coding of cause of death.<sup>9</sup>

**BIRTHS AND DEATHS REGISTRATION ACT 1953**  
(Form prescribed by Registration of Births and Deaths Regulations 1987)

**MEDICAL CERTIFICATE OF CAUSE OF DEATH**

For use only by a Registered Medical Practitioner WHO HAS BEEN IN ATTENDANCE during the deceased's last illness, and to be delivered by him forthwith to the Registrar of Births and Deaths.

Registrar to enter  
No. of Death Entry  
.....

Name of deceased .....

Date of death as stated to me ..... day of ..... Age as stated to me .....

Place of death .....

Last seen alive by me ..... day of .....

<p>1 The certified cause of death takes account of information obtained from post-mortem.</p> <p>2 Information from post-mortem may be available later</p> <p>3 Post mortem not being held.</p> <p>4 I have reported this death to the Coroner for further action. <i>(See overleaf)</i></p>	<p><i>Please ring appropriate digit(s) and letter</i></p>	<p>a Seen after death by me.</p> <p>b Seen after death by another medical practitioner but not by me.</p> <p>c Not seen after death by a medical practitioner.</p>
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**CAUSE OF DEATH**

The condition thought to be the 'Underlying Cause of Death' should appear in the lowest completed line - Part I.

I (a) Disease or condition directly leading to death† .....

(b) Other disease or condition, if any, leading to: **I(a)** .....

(c) ..... Other disease or condition, if any, leading to: **I(b)** .....

II Other significant conditions **CONTRIBUTING TO THE DEATH** but not related to the disease or condition causing it .....

*These particulars not to be entered in death register*

Approximate interval between onset and death

.....

.....

.....

.....

The death might have been due to or contributed to by the employment followed at some time by the deceased  Please tick where applicable

† This does not mean the mode of dying, such as heart failure, asphyxia, asthenia, etc: it means the disease, injury, or complication which caused death.

I hereby certify that I was in medical attendance during the above named deceased's last illness, and that the particulars and cause of death above written are true to the best of my knowledge and belief.

Signature ..... Qualifications as registered by General Medical Council .....

Residence ..... Date .....

For deaths in hospital: Please give the name of the consultant responsible for the above- named as a patient .....

## Box one

### GROUNDS FOR REFERRING A DEATH TO THE CORONER

ONS encourages the prevailing practice of voluntary referral to the coroner by the certifying doctor who should consider:

- Whether the death was
  - an accident (whenever it occurred);
  - a suicide;
  - related to the deceased's employment.
- Whether the death occurred during or shortly after detention in police or prison custody.
- Whether s/he or another doctor is legally qualified to certify the death.

A registrar is legally obliged to refer a death to the coroner (unless it has already been reported) if it falls, or appears from the doctor's death certificate to fall, into one of the following categories:

- The deceased was not attended during his or her last illness by a doctor.
- The registrar has been unable to obtain a duly completed death certificate, or else it appears that the deceased was not seen by the certifying doctor either after death or during the 14 days before death.
- The cause of death appears to be unknown.
- The registrar has reason to believe the death was unnatural, or caused by violence or neglect, or by abortion, or was in any way suspicious.
- The death appears to have occurred during an operation or before recovery from the effect of an anaesthetic.
- The death certificate suggests that death was due to industrial disease or industrial poisoning.

Source: Letter to all doctors in England and Wales from the Deputy Chief Medical Statistician, ONS, dated 1 July 1996.

The main effect of these changes on registration practice has been in the way deaths have been handled by local registrars. When a death occurs, the attending doctor will usually complete a medical certificate of cause of death (MCCD) (see left) which is taken to the local registrar, who generally produces a draft of the details about the death. Until recently the registrar carried out the registration by filling out a form by hand, but this practice is now uncommon. With computerisation of the registration service the details from the MCCD, and other particulars supplied by the informant (or, if there was an inquest, by the coroner), are entered into a PC by the registrar. Draft details about the death are then printed automatically, and the information stored and sent weekly on floppy disk to ONS for processing.

At present (November 1998) 97 per cent of death registrations are handled in computerised registration offices. Registrations in non-computerised offices are notified to ONS through paper drafts, from which information is keyed into the processing systems. Redevelopment in this area has meant that information about nearly all deaths can be handled more consistently and efficiently than before.

A new database was also introduced to store information on deaths. The information sent from registration offices is now loaded on to the database, and then processed and edited. Prior to 1993 ONS (then OPCS) produced an annual computer file containing details of all registrations in a particular year. In the new system there are in practice two deaths databases: one contains textual information corresponding to the public record – these are the details supplied by informants when registering a death, and to applicants requesting a copy of the death certificate – and the other is a statistical database, which contains only coded details of each death. Outputs are obtained by accessing the database to supply information, whether on individual deaths or as datasets to produce tabulations. Information on cause of death is held in coded form in the statistical database, and as text in the other (registration) database.

Information sent to ONS includes causes of death, which are coded to ICD9, and an underlying cause, identified by the Automated Cause Coding system (ACCS). About 80 per cent of deaths are now coded this way. The cause coding of deaths certified after inquest is still carried out clerically to ensure consistent handling of these cases.<sup>10</sup> The rules and procedures used in ACCS ensure more consistency than the clerical system, and have several advantages – improved consistency, better international comparability, and the automatic coding of all causes mentioned on most death certificates.

A revised reporting form for coroners introduced in 1993 changed the data on deaths from injury and poisoning. Less specific detail about the nature of injury is now available for external cause deaths, compared with previous years.<sup>11</sup>

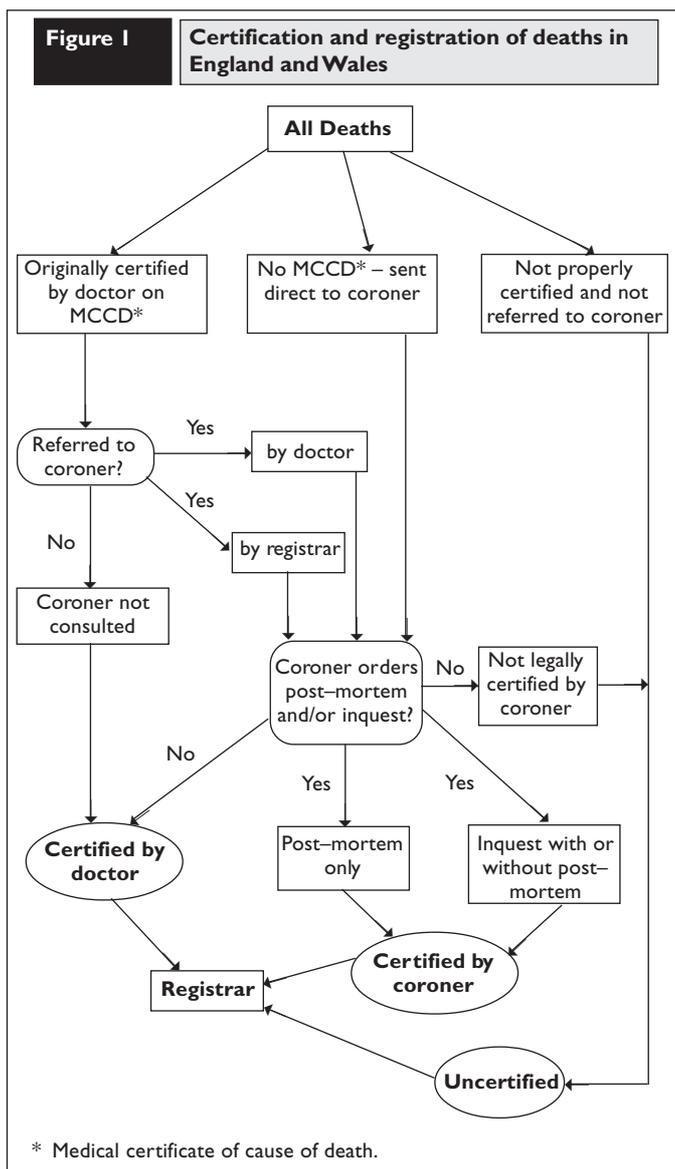
### CERTIFICATION

When a person dies the attending doctor completes the MCCD for the local registrar of births and deaths. The informant, often a relative of the deceased, delivers the doctor's certificate when s/he goes to register the death. The majority of deaths are handled in this way, and unless the registrar considers it necessary to refer the case to the coroner – which is unusual as only 1 per cent are so referred – the death is registered without further ado.

The registrar collects from the informant all the details for registration, except the cause of death. Other details required for statistical purposes are collected partly from the MCCD and partly from the informant. All these details appear in the draft entry prepared by the registrar, a copy of which is sent to ONS.

The MCCD is in a form prescribed by law,<sup>12</sup> and should be completed only by a doctor who has been in attendance during the deceased's last illness. Much of the epidemiological interest centres round the medical causes of death, and this part of the certificate is discussed below in more detail. Although the certifier gives the date and place of death, these details are entered in the register from the statement of the informant. Other information given by the certifier does not appear in the register, a copy of which is supplied to the informant, but is entered by the registrar for statistical use within ONS.

Most of these residual statistical details, such as when the deceased was last seen alive, whether the body was seen after death by the certifier, whether death was related to employment, and duration of illness for each medical condition mentioned, are analysed in annual published tables. Of the remainder, information on whether or not a post-mortem has taken place, and whether the death has been reported to a coroner, is valuable in analysing the treatment of more unusual deaths, and is discussed below. In addition, Box B (on the rear of the MCCD) is used by the certifier to indicate that more information may be available later.



For some deaths the doctor may certify the cause and report the case to the coroner, or the registrar may report it. Deaths which should be referred to the coroner by the registrar are listed in Box One.

Deaths for which there was no doctor in attendance, such as sudden or unexpected or violent deaths, may be referred directly to the coroner by the police. At this point the coroner has a number of possible courses of action. Where he is satisfied that the death is due to natural causes and the cause is correctly certified, he will instruct the local registrar (on form 100A) to register the death, using the cause of death given on the original medical certificate. If this certificate was not completed in the first place, the registrar will use the cause of death stated by the coroner on form 100A.

Alternatively, the coroner may order a post-mortem examination, particularly where the death was sudden and the cause unknown. If this shows unequivocally that the death was due to natural causes he may dispense with the requirement to hold an inquest. He will then certify the cause of death from the pathologist's report on the post-mortem (form 100B). The registrar will use this certificate to register the death.

If an inquest is necessary, the death can be registered only after the inquest. In nearly all cases the inquest follows a post-mortem by a pathologist. In most cases the inquest concludes the investigation and the death is then certified by the coroner (form 99(REV)). This provides the registrar with details of the deceased as well as the inquest findings as to cause of death.

If it appears that someone is to be charged with an offence in relation to the death, the coroner must adjourn the inquest until legal proceedings are completed. Since 1978 it has been possible to register these deaths at the time of adjournment, when the coroner issues form 120. This form includes details of injuries which led to the death, but no verdict. In the case of motor vehicle incidents, this will provide enough information to code the cause of death. Other deaths, such as possible homicides, are given a temporary code for underlying cause until final information becomes available.<sup>13</sup> This is supplied by the coroner to the registrar on form 121.

A very small proportion of deaths remains legally 'uncertified'. ONS receives copies of at least one medical certificate of cause of death for

**Table 1 Deaths by certifier, and by whether inquest and post-mortem carried out, England and Wales, 1879-1996**

Certification	1879 (%)	1928 (%)	1953 (%)	1963 (%)	1973 (%)	1987 (%)	1992 (%)	1996 (%)
Doctor with post-mortem	90	8	9	10	6	2	2	*
without post-mortem		83	77	73	72	74	76	*
	90	91	86	83	78	76	77	78
Coroner Post-mortem only	5	1	9	12	18	20	19	18
Inquest and post-mortem		7	2	4	4	3	4	4
Inquest only			3	1	1	0	0	0
	5	8	14	17	22	24	23	22
Certified with post-mortem	n/k	9	20	26	27	26	24	*
Uncertified	5	1	0	0	0	0	0	0
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>Total deaths†</b>	<b>526,255</b>	<b>460,389</b>	<b>114,642 **</b>	<b>572,868</b>	<b>587,478</b>	<b>566,994</b>	<b>558,313</b>	<b>560,135</b>

\* Doctor's post-mortems for 1996 could not be separately identified with accuracy.

† Numbers of deaths are registrations in each year except 1996, which are occurrences.

\*\* Deaths in second quarter of 1953.

Source: RGs Annual Reports for years 1879 to 1973; Annual Reference Volumes in DHI series for 1987 to 1996.

these cases, which are registered and coded as normal. This group includes deaths for which the doctor who completed the medical certificate did not fulfil all the legal requirements for doing so. For instance, the doctor was not in attendance on the deceased during the last illness and did not see the body, and the coroner did not order a post-mortem but issued form 100A. It also includes deaths of foreign military personnel (and their dependants) in England and Wales, where the certifying doctor was not a medical practitioner registered in England and Wales for the purpose of issuing certificates.

A copy of the MCCD is shown on page 22, while copies of the coroner's forms may be found at the back of any recent volume in the DH series, published by ONS. The processes of certification and registration in England and Wales are illustrated in Figure 1.

Table 1 shows the decreasing role of the doctor in death certification, and the increasing roles, particularly in tandem, of the coroner and pathologist who carry out post-mortems. These have been influenced on the one hand by changes in statutory responsibilities, e.g. 1926 Acts, and on the other by changing patterns in causes of death – for instance, a decline in deaths due to infectious diseases and a rise and fall in accidental deaths. Over the last three decades the pattern has stabilised, with coroners now certifying about one death in every four. The contribution of the pathologist is now mainly to coroners' cases.

### DOCTORS

Medical practitioners in England and Wales have been legally required to certify the cause of death for patients under their care since 1874. Current legislation requires that the doctor 'shall sign a certificate in the prescribed form stating to the best of his/her knowledge and belief the cause of death' for the death of any person attended during their last illness. The doctor is also required to deliver the certificate to the registrar.<sup>14</sup>

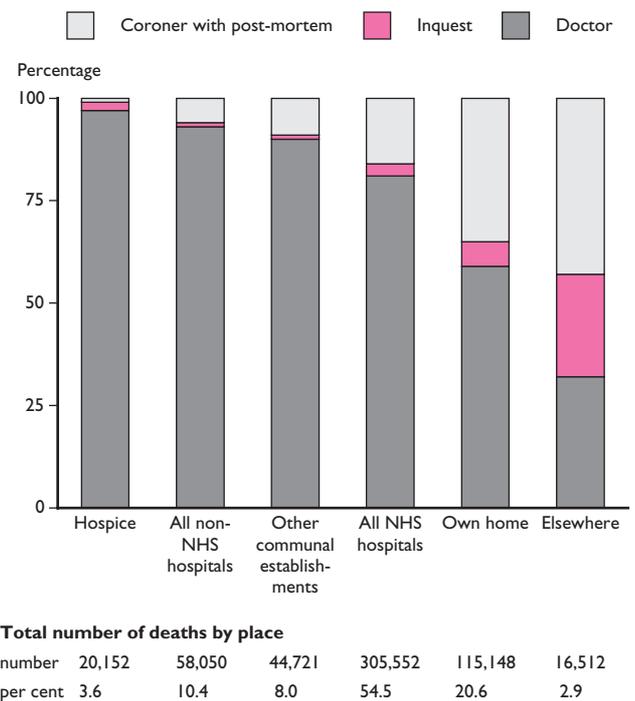
The legal responsibility for referring deaths to the coroner rests with the registrar of births, marriages and deaths, rather than the doctor. In practice 96 per cent of deaths (in 1996) which involved both a doctor and coroner were referred by the doctor,<sup>15</sup> often before completing the MCCD. In fact, if the coroner accepts jurisdiction, the doctor may not complete a MCCD at all since the registrar must then use the coroner's certificate to register the death. The Registrar General does not normally enforce completion of a redundant document in these cases.

To be able to complete the MCCD a medical practitioner must, by law, be fully registered with the General Medical Council. House officers in hospitals who are only provisionally registered may complete MCCDs only for patients who die in hospital, and are under the care of a consultant who is also supervising their training. The consultant should supervise the certification, having a responsibility to see that it is done correctly and in accordance with the law. Since 1986 the name of the consultant responsible for care of the deceased, as well as that of the certifier, must be entered on the certificate for all deaths in hospital. Any further enquiries are addressed to the consultant, who is more likely to be still available in the same post than are junior staff.

A high proportion of certificates are signed by doctors, normally without the benefit of post-mortem information. How experienced are these certifiers? Some insight into this may be gained from an analysis of doctor certified deaths by place of occurrence.

The place where a death occurred must be recorded by the registrar, and is usually based on details supplied by the informant. In 1996, 54 per

**Figure 2** Deaths in 1996 by place of death and per cent certified by doctors and coroners, with or without inquest, in England and Wales



cent of deaths took place in NHS hospitals and places for the care of the sick, which includes NHS nursing homes, while 10 per cent were in similar communal establishments outside the NHS; 21 per cent occurred in the deceased's own home, and 8 per cent in other communal establishments, which includes old people's homes.<sup>16</sup>

Figure 2 shows the percentage of deaths occurring in each of these places which are certified by doctors, by coroners after post-mortem only, and after inquest. Nearly all deaths in hospices are certified by doctors, as would be expected in communal establishments which care specifically for patients known to be terminally ill. At the opposite extreme, deaths most likely to be certified by coroners are those which occur 'elsewhere'. These include deaths at the scene of an accident as well as others outside the home or hospital. While 83 per cent of deaths in non-psychiatric hospitals are certified by doctors, the proportion of those in psychiatric hospitals is 90 per cent. Deaths in general hospitals will include some caused by accidents or violence where death is not immediate.

Of the 560 thousand deaths in 1996, 436 thousand were certified by doctors rather than by coroners. Sixty two per cent of these occurred in hospitals (270 thousand). Thus almost one half of all deaths are registered by hospital doctors – who are mostly junior.

### CORONERS

Coroners date from 1194, when they were created to fill the need for an official whose main duty was to protect the financial interest of the Crown in criminal proceedings.<sup>17</sup> This official was elected as a 'keeper of the pleas of the Crown' or *custos placitorum coronas*, from which the present name derives.<sup>18</sup> Over time the duties changed, so that by 1500 the main function performed by the coroner was the holding of inquests into violent deaths. The 1887 Coroners Act established that coroners were concerned not so much with safeguarding financial

## Box two

### DEATHS REFERRED FOR FURTHER INVESTIGATION IN SCOTLAND AND NORTHERN IRELAND

In both Scotland and Northern Ireland the procedures for certifying and registering most deaths are similar to those in England and Wales. However, in Scotland the registrar of deaths is obliged to report to the procurator fiscal any death which falls into a broad range of some 20 categories. Deaths may also be reported to the procurator fiscal by the police or by attending doctors. When a death has been referred to him, the fiscal must decide whether any further enquiry is necessary, for instance whether to request an autopsy. The death meanwhile will have been registered in the normal way, and the information passed to the General Register Office for Scotland (GRO(S)), where it will be used to code the cause of death.

The procurator fiscal is responsible for prosecution of criminal offences in his district, as well as for investigating any sudden, violent, suspicious or accidental death, or death from an unknown cause, which is reported to him.<sup>25</sup> The main aim for the fiscal is to establish whether or not there has been any criminality or possible negligence involved in a death. In such cases he must report the results of his investigation to the Crown Office. There a decision is made as to whether criminal proceedings are to be instituted, or a public enquiry held, or no further action taken. He is not obliged to establish the precise cause of death in a medical sense, once the possibility of criminal proceedings has been ruled out. His enquiries are conducted informally and in private.

When the procurator fiscal has completed his examination of the case he informs GRO(S) of any changes to the information originally recorded on the death certificate, including clarification of the cause of death. GRO(S) will amend their records accordingly and, if necessary, change the code assigned to the death.

In 1996 registrars notified procurators fiscal of the particulars of 12,516 deaths where the circumstances indicated that the fiscal might wish to enquire into the cause of death.<sup>26</sup> The number notified constituted 21 per cent of all deaths. In 1,443 (12 per cent) of these cases, reports were subsequently received from the procurators fiscal, of which 1,264 (10 per cent) warranted amendments to the particulars given in the relevant death entries. There is no equivalent to the inquest in Scotland, but there are a small number of fatal accident enquiries, covering usually less than 100 deaths annually.

In Northern Ireland cases are referred to a coroner in much the same way as in England and Wales, although the list of formal grounds for referral is more general than in Scotland or England and Wales, including for example deaths 'as a result of violence or misadventure, or by unfair means'. Referrals to a coroner in Northern Ireland are relatively less common – 2,799 deaths were referred in 1996 (18 per cent of all deaths). For 1,047 of these deaths the coroner indicated that there was no reason to dispute the certified cause of death, and for a further 1,268 the coroner stated that a post-mortem had been carried out but, again, there was no reason to dispute the certified cause. Inquests were conducted on the remaining 484 deaths in that year.

**Table 2** Deaths referred to coroners by source of referral, England and Wales, 1987 to 1996

Source of referral	1987 (%)	1992 (%)	1996 (%)
<b>Formally referred</b>			
Doctor	17	19	24
Registrar	1	1	1
<b>Not formally referred</b>			
Certified by coroner, not referred	11	8	5
Certified by doctor, not referred	72	72	70
Uncertified and not referred	0	0	0
	100	100	100
<b>Number of deaths</b>	<b>566,994</b>	<b>558,313</b>	<b>560,135</b>

Source: ARV DHI 1987 (table 9), 1992 (table 9), 1996 (table 21).

interests, but in providing a service for the investigation of both the cause of and the circumstances surrounding deaths. Thereafter the coroner's interest in medical causes of death grew with the need for more precise information on mortality. A later act, of 1926, empowered the coroner to order an autopsy without having to proceed to an inquest, and to adjourn inquests where someone had been charged with an offence related to the death.<sup>19</sup> A review of the law and practice on medical certificates of cause of death, and of coronial practice and the reporting of deaths to coroners, produced some wide ranging recommendations in 1971<sup>20</sup> but few of these have been brought into operation, although a recent act consolidated other changes in the intervening years.<sup>21</sup> Comparable procedures for reporting deaths requiring further investigation for Scotland and for Northern Ireland are shown in Box Two.

The main duty of a coroner is to enquire into certain deaths occurring in his district.<sup>22</sup> His only other significant function is to conduct inquests into treasure trove. Each coroner is appointed by a local authority, such as a county council, metropolitan district or London borough.<sup>23</sup> A coroner will be either an experienced barrister or solicitor, or a legally qualified medical practitioner of at least five years' standing.<sup>24</sup>

Although there are formal requirements for referral to coroners, doctors are also encouraged to seek informal advice from coroners in cases where there is some doubt about the need to refer. There are no reliable statistics on the number of informal referrals. In 1996, 30 per cent of deaths were formally referred to coroners, of which nearly all were from doctors (Table 2). The legal responsibility for referral which is placed on registrars is usually only a backstop, generating about 4 per cent of all referrals. A further 18 per cent come from other sources, such as the police. Referrals by the doctor have increased since 1987, from 60 per cent of referrals to 80 per cent in 1996.

In many cases, referral to a coroner does not mean that he will certify the death (Table 3). For 27 per cent of formal referrals in 1996 the coroner saw no need to conduct any further investigation, and accepted the cause of death given by the attending doctor. The proportion so accepted has nearly doubled in recent years. The remaining 73 per cent of referred deaths almost always involved a post-mortem investigation.

Post-mortems may be carried out by pathologists for coroner enquiries, or to assist doctors in certifying cause of death. Most (93 per cent in 1992) are for coroners – see Table 4. The remainder form only 1 in 50 of all deaths certified by doctors; figures later than 1992 are not available at present.

## INVESTIGATION OF CAUSE OF DEATH BY POST-MORTEM AND INQUEST

The proportion of deaths certified by doctors which have been subject to autopsy has been extremely low for many years (Table 4). This may be explained in part by higher levels of diagnostic certainty related to modern ante-mortem investigative techniques. At the same time this means that there is decreasing pathological audit of the validity of clinical death certification. A recent study of certificates completed by various grades of hospital clinicians, GPs and pathologists found that senior hospital doctors make more errors than their juniors, while GPs and pathologists make fewest errors.<sup>27</sup> This agreed with other studies showing that inaccuracies in death certification arise from inadequate formulation of cause of death and failure to record relevant information.

Doctors can certify deaths only where they know the cause. They can request a post-mortem with the next of kin's consent. Figure 3 shows that in 1992 post-mortems for deaths certified by doctors were most common for infant deaths.

Coroners certify nearly a quarter of all deaths in England and Wales but most of these cases involve neither an inquest nor any suspicion of violence. They are referred to the coroner because they were sudden and unexpected, because there was no doctor in attendance during the deceased's last illness, or because the doctor who did attend is not available to give a certificate – for example, the patient's general practitioner may be on holiday and s/he has not consulted another doctor. In these circumstances, if post-mortem examination establishes a clear natural cause of death the coroner need not hold an inquest. S/he

**Table 3** Deaths referred to a coroner, and subsequent action, England and Wales, 1987 to 1996

Certification and action after referral	Total deaths			Referred deaths		
	1987 (%)	1992 (%)	1996 (%)	1987 (%)	1992 (%)	1996 (%)
<b>Referred to coroner</b>						
<i>Certified by coroner</i>						
No inquest, with post-mortem	20	19	18	71	67	61
Inquest, with post-mortem	4	4	} 4	14	13	} 12
Inquest, without post-mortem	0	0		0	0	
<i>Certified by doctor</i>	4	6	8	15	20	27
Total referred to coroner	28	28	30	100	100	100
<b>Not referred to coroner</b>	72	72	70			
	100	100	100			
<b>Number of deaths</b>	<b>566,994</b>	<b>558,313</b>	<b>569,683</b>	<b>158,463</b>	<b>156,899</b>	<b>169,944</b>

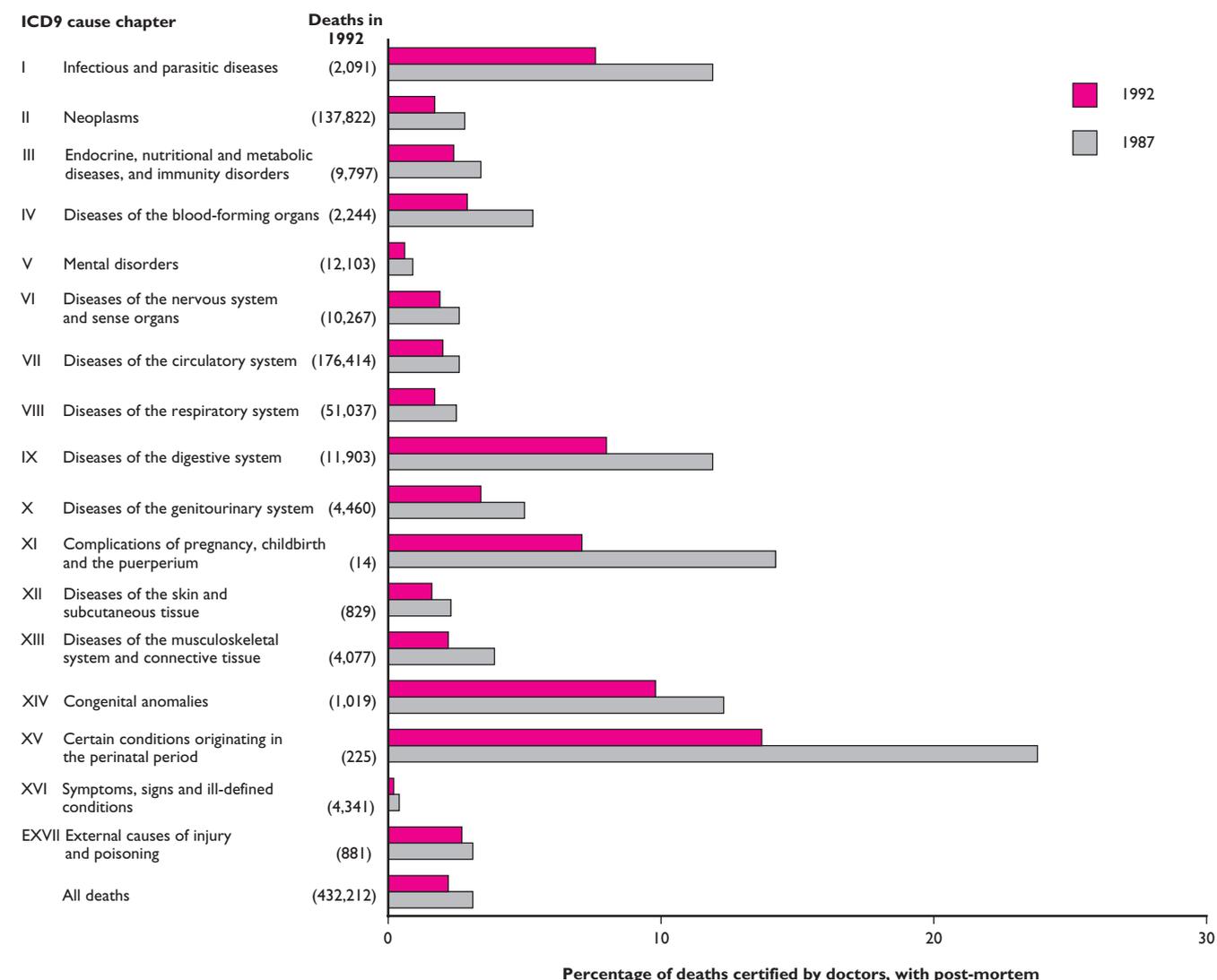
Source: ARV DHI 1987 (table 9), 1992 (table 9), 1996 (table 21).

**Table 4** Certification of deaths by whether post-mortem carried out, England and Wales, 1987 and 1992

Certification	1987			1992		
	Total deaths (%)	Deaths with post-mortem (%)	Deaths certified by doctors (%)	Total deaths (%)	Deaths with post-mortem (%)	Deaths certified by doctors (%)
By doctor, with post-mortem	2	9	3	2	7	2
By coroner, with post-mortem	24	91		22	93	
Certified with post-mortem	26	100		24	100	
By doctor, without post-mortem	74		97	76		98
Total certified			100			100
Other (uncertified)	0			0		
Total deaths	100			100		
<b>Number of deaths</b>	<b>566,994</b>	<b>148,643</b>	<b>431,783</b>	<b>558,313</b>	<b>134,826</b>	<b>432,212</b>

Source: ARV DHI 1987 (table 9) and 1992 (table 9).

**Figure 3** Percentage of deaths by underlying cause which are certified by doctors with post-mortem examination, England and Wales, 1987 and 1992



Source: ARV DHI 1987 (table 10), 1992 (table 10).

may certify the cause of death based on the pathologist's post-mortem findings. About 40 per cent of deaths from ischaemic heart disease, which may occur suddenly in people without previous symptoms, are certified by coroners in this way (Figure 4). In contrast only about 5 per cent of cancer deaths, where the course of the disease is often long and diagnosis is usually confirmed by biopsy or other tests before death, are certified by coroners. Only 2 per cent of cancer deaths are subject to inquest, usually to investigate possible industrial causes.

The causes of death which are most often certified after post-mortem and/or by coroners reflect the necessity for investigation for legal reasons or because the cause is unknown (Figure 4). Thus, 90 per cent of deaths from external causes in 1996 were subject to post-mortem and inquest before certification by coroners. Virtually the only exceptions were deaths due to falls and fractures, mainly of the elderly (60 per cent with coroners inquest, 9 per cent with coroners post-mortem only and 31 per cent by doctors).

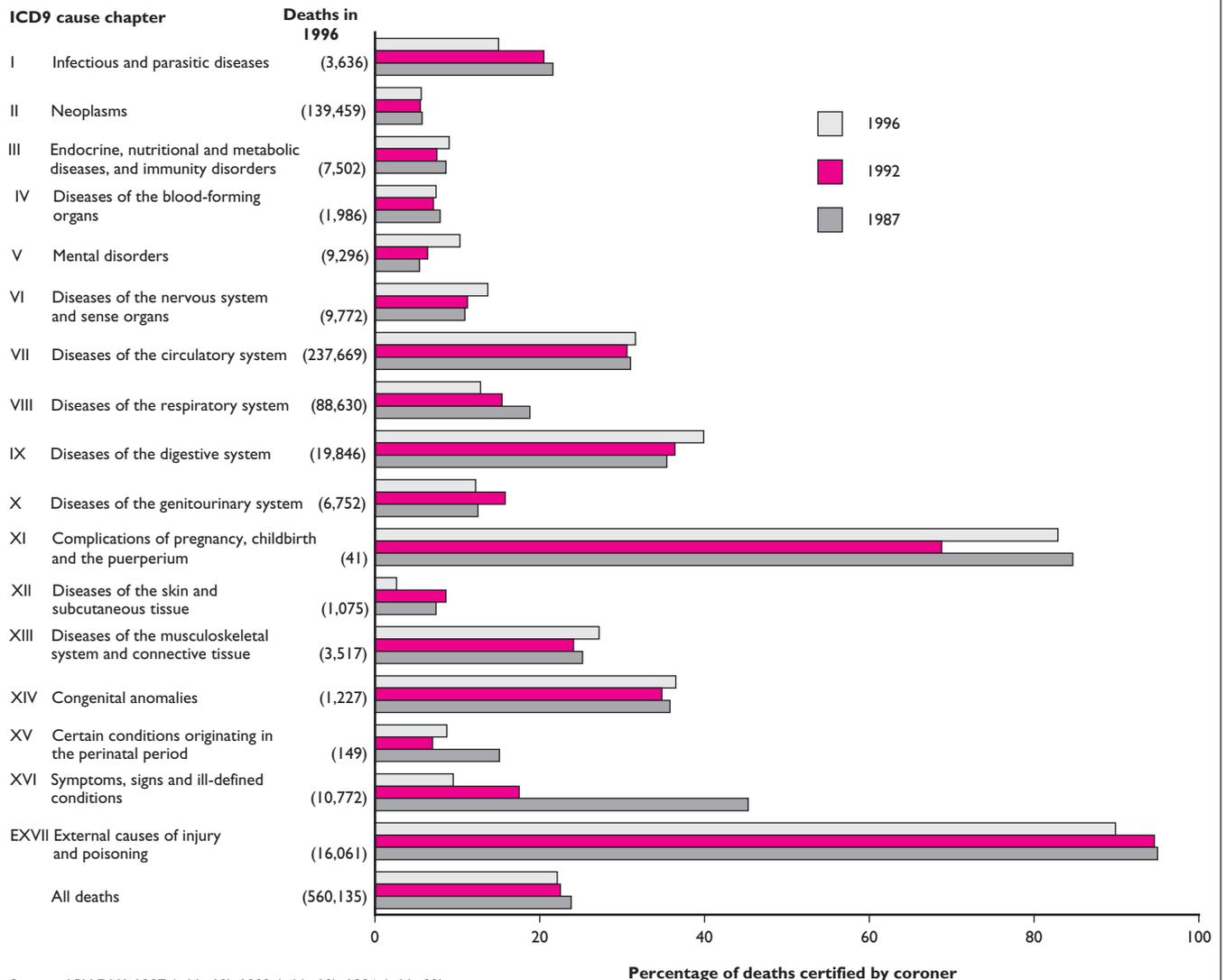
In contrast, only 10 per cent of deaths due to mental disorders (largely senile dementia) have had post-mortems. This partly reflects the long course of such illnesses, but also what causes can be found at autopsy.

Thus, though other research has shown that in 90 per cent of deaths from suicide a history of mental illness can be established,<sup>28</sup> only 12 per cent of suicide certificates in 1996 mentioned mental disorders. All these suicide deaths are subject to post-mortem as well as inquest.

Pathologists carrying out post-mortems for coroners may not have access to any information on the medical history of the deceased.<sup>29</sup> Any history they are given is more likely to come from the police than a doctor. The primary purpose of such examinations is legal – to rule out accidents, violence or unnatural causes. It is not to test the validity of clinical diagnosis nor to produce accurate statistics of causes of death.

The proportion of deaths due to signs, symptoms and ill defined causes (ICD9 chapter XVI 780–779) which are certified by coroners has fallen considerably since 1987 (see Figure 4). Instructions in books of certificates were changed in 1986 and now state that 'in deaths in the elderly when no specific condition is identified as the patient gradually deteriorates and dies, "old age" or "senility" is acceptable as the sole cause of death for persons aged 70 and over'. The number of deaths certified as due to 'old age' (ICD9 797) has risen steadily since 1986 to more than 8,500 in 1996. Most of these are at ages over 85, and are

**Figure 4** Percentage of deaths by underlying cause which are certified by coroners with post-mortem examination, England and Wales, 1987, 1992 and 1996



Source: ARV DHI 1987 (table 10), 1992 (table 10), 1996 (table 22).

certified by doctors without post-mortem. Nearly all deaths from other causes in this ICD chapter, such as sudden infant death syndrome (SIDS), or sudden adult death, or where no cause could be ascertained, are still certified by coroners. Only in the case of SIDS are these deaths usually certified without holding an inquest in addition to post-mortem.<sup>30</sup>

The type of death referred to a coroner may alter over time with a changing perception of what is natural or unnatural, and with whether some legal responsibility for the death may fall on a third party. For instance, deaths from Creutzfeldt-Jakob disease (CJD) were rarely certified by coroners before 1990 unless there was a history of treatment with hormones derived from pooled human pituitaries. However, in the past few years CJD deaths have been increasingly subject to inquest, which may lead to long delays in their registration.<sup>31</sup> All such cases should have been referred to the United Kingdom CJD surveillance unit in Edinburgh, usually before death, irrespective of how the death is eventually certified and registered. Up-to-date figures on presumed and confirmed cases and deaths from sporadic, iatrogenic and new-variant CJD are now available from the UK CJD surveillance unit.

### SELECTING THE UNDERLYING CAUSE OF DEATH

Mortality statistics, including those referred to above, are usually based on a single cause per death. This is the 'underlying cause of death', defined by the World Health Organisation (WHO) as '(a) the disease or injury which initiated the train of events directly leading to death, or (b) the circumstances of the accident or violence which produced the fatal injury'.<sup>32</sup> This is generally the most useful single cause for public health purposes.

The medical certificate of cause of death in England and Wales has been in the format recommended by WHO since 1927. In part I, which has three lines, the certifier is asked to state the conditions leading directly to death, starting with the immediate cause on line Ia and going back through the sequence on subsequent lines. Part II is for other conditions which contributed to the death but were not part of the direct causal sequence.<sup>33</sup> If the death certificate has been properly completed, with only one condition on each line, and the conditions in part I forming an acceptable sequence, the general rule can normally be used to select the condition entered in the lowest completed line of part I as the underlying cause (UCD).

**Table 5** Deaths by type of certificate, number of causes per line, and determination of underlying cause, England and Wales, 1986 and 1996

Type of certificate	Percentage of total deaths		Percentage where underlying cause is derived by general rule	
	1986	1996	1986	1996
<b>Simple certificate (one cause per line)</b>				
Line Ia only	20	25	100	100
Lines Ia and II	9	10	54	91
Lines Ia and Ib	32	28	74	77
Lines Ia, Ib and II	8	10	62	72
Lines Ia, Ib and Ic	8	6	56	56
Lines Ia, Ib, Ic and II	2	2	51	57
<b>Complex certificate (more than one cause on at least one of the lines)</b>	22	20	n/k	n/k
<b>Total</b>	<b>100</b>	<b>100</b>		

Source: 1986 figures from Ashley and Devis paper, table 7; 1996 figures from unpublished tables.

If the death certificate has not been completed correctly, it becomes necessary to apply one or more of the three selection rules in the Ninth Revision of the International Classification of Diseases (ICD9).<sup>34</sup> In addition, there are nine modification rules which apply to particular conditions, combinations or circumstances. For example, two or more mentioned conditions may be linked to derive a composite underlying cause, so that renal failure (ICD9 code 586) due to hypertension (401) becomes hypertensive renal disease (403). Later stages of the same disease process are preferred to earlier ones – acute myocardial infarction (410) rather than ischaemic heart disease (414); and trivial or ill defined conditions, or senility, may be ignored when this allows the coder to select a more specific or lethal condition. The purpose of these rules is to derive the most useful information from the death certificate, even when it has been badly completed, and to do this uniformly so that data will be comparable between places and times.

Table 5 shows clearly that the proportion of deaths for which the underlying cause was selected using the general rule is higher in 1996 than it was in 1986 – that is, ONS is now following international practice more closely, and overturning the opinion of the certifier less often than ten years ago. The greatest increase, in both relative and absolute terms, in the use of the general rule is on certificates which have only a single condition in part I on line a, and one or more conditions in part II. This probably reflects changes in the application of ICD9 rule 3 over time.

### ICD9 Rule 3

Rule 3 as published by WHO states that ‘if the condition selected by the general rule, or rules 1 or 2, can be considered a direct sequel of another reported condition, whether in part I or part II, select this primary condition. . .’<sup>35</sup> For example, if the certifier has written ‘renal failure due to obstructive uropathy’ in part I and ‘benign prostatic hypertrophy (BPH)’ in part II, the coder would assume the BPH to be the condition which initiated the sequence leading to the renal failure. In 1984 OPCS introduced a much broader interpretation of rule 3. This happened because an increasing proportion of certificates were noted to have in part I only a condition which was considered likely to be the terminal event in a person made immobile, disabled or ill by other conditions present for a longer time, which the certifier placed in part II. In particular, there had been very large increases in the proportion of deaths ascribed to bronchopneumonia, especially in the elderly.

The 11 conditions considered terminal included pneumonia (of any type), pulmonary embolism, venous thrombosis and embolism, cardiac or hepatic failure, and cardiac arrest.<sup>36</sup> In the broader OPCS interpretation of 1984, when any of these conditions would have been the underlying cause, and any other major condition was recorded in part II, rule 3 was to be used to select that major condition. No evidence for an aetiological or pathological sequence was required: the presumption was simply that these 11 conditions could be the ‘terminal event’ in any disease process.

This meant, for instance, that schizophrenia or rheumatoid arthritis in part II could be selected as the underlying cause of renal failure or pneumonia in part I. This change led to an abrupt fall in deaths ascribed to pneumonia and the ten other less common conditions regarded as terminal, and a corresponding apparent rise in deaths from many predominantly chronic conditions, including mental disorders. Deaths registered in 1984 were independently coded according to both the old international, and the OPCS only rules. The results of this bridge coding were compared to calculate conversion ratios for every cause affected, so that time trends could be interpreted across the change. The broader interpretation of rule 3 continued for all deaths registered in England and Wales from 1984 until the automated system for coding cause of death (ACCS) was introduced in OPCS in 1993.<sup>37</sup> This incorporates software developed in the USA, and so applies the American interpretation of the WHO rules – which are probably closer to those used internationally. A description of the effects of moving back to the internationally accepted interpretation of rule 3 has been published by ONS.<sup>38</sup>

**Table 6** Multiple cause of death data, England and Wales, 1986 and 1996

ICD9 code	Medical condition	1996 deaths			1986 deaths
		Underlying cause	Mentioned causes	Mentions/underlying cause	Mentions/underlying cause
162	malignant neoplasm of lung	30,810	32,807	1.06	1.05
174	malignant neoplasm of female breast	12,179	15,084	1.24	1.15
250	diabetes	5,994	23,682	3.95	2.90
290	organic psychoses	6,592	15,191	2.30	1.60
295	schizophrenia	36	534	14.8	3.07
410	acute myocardial infarction	68,356	73,852	1.08	1.07
428	heart failure	9,753	73,748	7.56	13.5
436	acute cerebrovascular disease	39,273	52,279	1.33	1.20
485	bronchopneumonia	45,644	99,115	2.17	5.34
785	cardiovascular symptoms	40	6,121	153	169

Source: ARV DH2 1985; unpublished 1996 data.

## MULTIPLE CAUSES OF DEATH

Multiple cause data, in which all the conditions mentioned by the certifier are coded, are available for 1985 and 1986 and all years since 1993. The data can be used to elucidate the effects of changes in selecting the underlying cause of death (UCD) on routine mortality statistics. Analyses of multiple cause data help to show the contribution of particular diseases in the death process, as well as allowing some measurement of associations between diseases. Table 6 shows that some conditions are nearly always selected as the underlying cause of death whenever they appear on the certificate. These include major cancers and acute cardiovascular events, including myocardial infarction and stroke. In contrast, there are nearly four times as many deaths with diabetes mentioned as have it selected as the underlying cause. Symptoms, signs and ill defined conditions such as cardiorespiratory arrest are often given as the immediate cause, but hardly ever selected as the underlying cause, unless there is no other choice.

The ratio of mentions to UCD gives an indication of how much the UCD statistics could be inflated by changes in the selection rules. There is comparatively little scope for artefactual increases in rates of death from acute myocardial infarction, which is nearly always selected as the underlying cause of death whenever it appears. The same is true of malignant neoplasm of the lung. This largely reflects the views of certifiers that these conditions are directly lethal. The ratio of mentions to UCD is a little higher for breast cancer, reflecting the better survival, so that this condition may appear in part II of the certificate in elderly women dying of other conditions.

Much higher ratios are seen in conditions such as heart failure, which may be caused by a variety of pathologies; diabetes, which may be placed in part II when it complicates treatment of other conditions and so compromises survival; chronic degenerative conditions such as organic psychoses (these deaths are mostly senile dementia), which certifiers appear not to regard as lethal; terminal conditions such as bronchopneumonia; and ill defined descriptions of symptoms and signs. Changes in the proportion of any of these conditions selected from the large pool of 'mentions' can have very large effects on their apparent underlying cause mortality rates.

Differences in the ratios of mentions to underlying cause between the mid-1980s and the 1990s shed further light on the changes in UCD selection when automated coding was introduced in 1993. The higher ratio of mentions/UCD for diabetes and organic psychoses in the 1990s shows that the reversion to the international interpretation of rule 3 has made selection of these conditions as the underlying cause less likely now. In contrast, bronchopneumonia is two and a half times as likely to be selected as UCD now as it was ten years ago. Heart failure and cardiovascular symptoms are also more likely to be selected now.

## ENQUIRIES

As noted above, the conditions mentioned on the death certificate are used to derive an underlying cause of death. However, in some cases more information on causes of death may become available later, such that the underlying cause may be subsequently amended. At present, the ways in which this may happen are:

- by the certifying doctor indicating on the front of the medical certificate that information from a post-mortem may be available later;
- by the certifying doctor indicating on the back of the MCCD (in Box B) that more information may be available later (for example, results of bacteriology tests taken before death);
- by coroners certifying deaths after post-mortem but without

inquest, indicating that results of histology or bacteriology tests may be available later;

- following an inquest, the second page of the coroners certificate – which provides details of how a fatal accident occurred – is posted to ONS by the registrar, and may arrive later than the electronic registration;
- where an inquest has been adjourned and an accelerated registration carried out, the coroner may later provide a final underlying cause and verdict.

In the first three instances, the registrar is obliged to send a request for this further information at the same time as registering the death. In the last two instances, the deaths processing branch in ONS may send an enquiry if the expected information has not arrived after a suitable interval.

In 1996 there were some 14 thousand deaths where Box B on the MCCD was ticked, and from subsequent enquiry the underlying cause was amended for about 20 per cent of these. These enquiries are open-ended and their effect is limited – few medical conditions are affected, and many of the amendments result in changes only within the same three-digit ICD code.

As well as these five sources of further information 'medical enquiries' (MEs) have been made by the Registrar General's Office in most years since 1881.<sup>39</sup> These enquiries were sent to certifiers if insufficient details had been provided on the certificate for coding the cause of death precisely.

Coders used a standard list of ICD codes which would generate a medical enquiry if selected as the original underlying cause on a death certificate. No follow-up was sent if the ME produced no reply, and enquiries were not normally sent for deaths at age 75 or over. An example of an enquiry is where the death certificate was due to 'malignant melanoma, site unspecified' – the certifier would be asked for the exact site of the primary growth, if known.<sup>40</sup> An enquiry form was also used for neonatal deaths.

OPCS used this system up to 1992, when it was abandoned as it was not possible to deal with these deaths in a timely way, nor to generate enquiries easily from the (new) automated coding system. In any case, studies of the effects of enquiries on mortality statistics in the early 1990s suggested that the system needed review. This was one of many changes which took place in 1993 at the time of redevelopment. Not using medical enquiries meant that from 1993 the numbers of deaths assigned to less specific causes increased, while the number from more specific causes decreased. Many conditions where medical enquiries produced this 'loss' of numbers are those with less well-defined descriptions. Examples are: malignant neoplasm of other and ill-defined sites (ICD 195), malignant neoplasm without specification of site (ICD 199), and other diseases of respiratory system (ICD 519). Complementing these are conditions where numbers show a marked net increase, such as malignant neoplasm of small intestine (ICD 152) and bacterial meningitis (ICD 320). For most conditions the effects were small, but and these have been analysed in some detail.<sup>41</sup>

## CONCLUSIONS

The process of death registration in England and Wales is a very complex one. It is governed by a variety of laws and regulations which have accumulated over more than a century and a half. Information gathered through these processes is used for public health planning and evaluation, resource allocation, epidemiological and clinical research and a variety of other purposes. These purposes are not all necessarily well served by the current system for investigating and certifying cause of death.

Doctors have little training in how to complete medical certificates of cause of death, and uncertain knowledge of their legal obligations. Many are unaware of the uses to which the information they give will be put, including the policy decisions which may ultimately affect their own practice. The key issues for certifiers are the identification of a sequence

of events (where present), together with a clear understanding of the nature of the underlying cause of death. These could be addressed by better training in certification of medical students and junior doctors, and in the uses of cause of death data. With this appreciation many doctors might take more care in filling out MCCDs, in particular providing as much relevant information as possible, on the standard certificate. A video was produced by ONS in 1995 to assist in training.

Investigation of the cause of a quarter of all deaths, the vast majority of which are due to disease, is left to coroners, whose purpose is to prevent homicide going undetected, and to provide a final check on other legislation affecting public safety such as industrial health and safety. This is not a system designed to provide reliable, uniform, good quality information on deaths from diseases for public health purposes or for medical and epidemiological research. In addition, coroners certify many deaths from natural causes for purely administrative reasons: there is no doctor in attendance available to give a certificate. Alternatives are possible. For example, investigation of sudden and unexpected deaths in Sweden is the responsibility of a local public health official, who may consult medical personnel and records before deciding whether autopsy or other investigation is required.<sup>42</sup>

Many data users have little knowledge of the processes involved in producing mortality data, or of the effects these have on the accuracy, comparability and reliability of the end information. This paper provides some information, and reference to other sources, to help interpret routine statistics and research. Further analyses of multiple cause data will appear in forthcoming ONS publications. These data will be made available to researchers, on request.

There are also possible improvements for ONS to consider. A revised system for medical enquiries which makes a significant improvement to information on cause of death, is being considered for implementation in the near future, in conjunction with the move to ICD10 coding. More fundamental would be an overhaul of the legislation governing death certification, investigation and registration, and of restrictions surrounding release for medical and epidemiological research of data collected at death registration.

## Key findings

- Certification and registration is straightforward for 70 per cent of deaths, requiring a doctor to certify the cause(s) and a registrar to enter these and other details in a register.
- In about 30 per cent of cases the death is referred to a coroner, and in about 4 per cent an inquest is subsequently held. Most of the inquest deaths are from accidental or violent causes.
- From 1993 ONS has used cause coding rules more in line with international practice, enabling greater consistency and easier comparison.
- It is now possible to analyse all conditions mentioned on death certificates, leading to a better understanding of particular diseases in the death process.

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