An Investigation of the Processes of Confirmation and Certification of Coronary Heart Disease Deaths in Glasgow.

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C O N T E N T S

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Coronary mortality rates for men and women in Glasgow are amongst the highest in the world. Recent studies have questioned the reliability of published mortality data. This study describes the process of death certification in Glasgow, indicating the diverse ways in which deaths occurring in a variety of circumstances are processed by a variety of types of person so that a death certificate can be issued. The study uses this information to assess the reliability of the coronary mortality data in a manner similiar to "validity exercises" carried out elsewhere, except that the results are presented in an operational and social context. Finally, the study discusses possible measures which might be taken to improve the reliability of the coronary mortality data.

Information was collected from general practice records, hospital records and pathology departments and procurator fiscal records for all deaths contained in the Registrar General coronary mortality data for 1984 for men and women under 65 resident in Glasgow, North of the Clyde. The data were then used to assess the proportion of cases where (a) data collection was incomplete and (b) where data were as complete as possible, but the diagnosis could not be substantiated.

14% of the coronary death certificate diagnoses could not be substantiated using the W.H.O MONICA criteria for

myocardial infarction. In 1% of cases complete documentation was not obtained for the validation exercise. In a further 1%, there was clinical or pathological evidence of coronary heart disease which did not meet the W.H.O. criteria. In a further 3%, death had been attributed to an alternative pathology and these cases should not have been contained in the Registrar General data for coronary mortality.

In the remaining 9% of cases there were neither symptoms nor a previous medical history of coronary heart disease to suppport the diagnosis made at death. One-third of these cases had been certified by a GP without referral to the procurator fiscal, and in virtually all cases the symptoms prior to death had not been recorded in the GP notes.

The remaining cases had been notified to the procurator fiscal who did not request a post-mortem investigation. If these cases had had post-mortem evidence of significant coronary heart disease in the absence of other pathology, the proportion of substantiated cases would have been increased by 6%.

The practicality of possible measures to increase the proportion of substantiated cases are discussed in the context of the medico-legal and social systems which are involved in the process of death certification.

I N T R O D U C T I O N

Coronary mortality rates for men and women in Scotland are among the highest in the world. The male coronary death rate appears to be falling. However, the rate of the decline is much slower than in other countries. Coronary mortality rates for Scottish women have been the highest in the world since 1971 (1).

Within Scotland there is marked regional variation, with higher coronary death rates in the west (2,3). For men and women under 65 years, rates in Glasgow were 13% and 26% above the national average in 1984. Comparison of mortality data for 1984, based on death certificates from 32 centres participating in the World Health Organisation MONICA Project, showed the Glasgow MONICA population in the second highest position in the coronary mortality league for men and the highest position in the league for women. With the exception of the Siberian MONICA population, the coronary death rate for women in Glasgow was 50% higher than those of any other participating centre (4).

The apparent decline in coronary mortality in some countries and the lack of decline in others, for example the United Kingdom, has aroused considerable epidemiological interest. Some authors have attempted to explain the reduction in coronary heart disease mortality on the basis of improved medical care such as, the treatment of hypertension, the use of B-blockers,

coronary artery bypass grafting and the provision of pre-hospital and in-hospital coronary care facilities (5-7). Others have related the decline in coronary mortality to a fall in the incidence of coronary heart disease due to a reduction in the levels of community risk factors such as cigarette smoking, dietary fat intake, obesity and physical inactivity (5,8,9). However, without information on non-fatal coronary heart attacks, the pattern of medical care and community risk factor levels it is impossible to assess what impact these factors have had on coronary mortality rates.

Other authors have questioned the validity of published mortality data which have been the basis of much epidemiological research in coronary heart disease. They suggest that trends in coronary mortality within a population and differences between populations, may represent only changes and differences in the diagnostic and coding practices of death certification. (10,11)

On the basis of the uncertainity that exists regarding the reliability of mortality data this study examines the 1984 data which gave Glasgow its high coronary mortality rates in order to ascertain whether the death certificate diagnoses can be substantiated using standardised criteria. By investigating these deaths in relation to the certifying doctor and the evidence available supporting the diagnosis, the study assesses

whether published data reflect the true picture of coronary mortality in Glasgow.

By investigating the place and circumstances of death and the medical and legal agencies involved in the process of confirmation and certification of the death, the study then describes the diagnosis in the context in which it was made and assesses whether there are any factors other than medical that determine how a death is certified.

Finally, the study assesses whether there are any measures which might be taken to improve the reliability of mortality data, and the effect this might have on published mortality data.

LITERATURE REVIEW

General Background

The issue of a Medical Certificate of Cause of Death (death certificate) became a legal requirement in the United Kingdom in 1837. Its primary functions were to provide legal proof of death and to assist in compiling population registers. As the system developed secondary functions emerged which were to provide accurate mortality data and improve medical understanding of diseases.

In 1891, the International Statistical Institute charged a committee with the preparation of a classification of causes of death. Its report was accepted in 1893 and recommended a classification whose underlying principle distinguished between general diseases and those which are localised to a particular organ or anatomical site. In 1899, it was decided to review the classification every ten years. In 1949, the Sixth International Review Conference radically changed the classification to include non-fatal diseases and established rules for selecting the underlying cause of death.

The underlying cause of death is defined as the disease or injury which initiates the train of morbid events leading directly to death. In published statistics only the underlying cause is taken into account.

The death certificate recommended by the World Health Organisation is in two parts. Part 1 records the sequence of diseases or conditions directly leading to death. Part 2 records conditions which have contributed to death but which were not directly involved in the causal sequence.

England and Scotland have different death certificates, both of which meet the above recommendations (see Appendix 1).

Important differences exist between England/Wales and Scotland in the procedures by which the cause of death is certified. In England and Wales it is a legal requirement that the certifying doctor is a registered practitioner familiar with the deceased's medical history, and who attended the patient within 14 days prior to death. In practice deaths which occur in hospital are often certified by the hospital doctor if he was in attendance during the terminal event. This is technically illegal. In Scotland, any doctor who feels competent to do so may complete the certificate "to the best of his knowledge and belief". There is no legal requirement that the certifying doctor is either a registered practitioner familiar with the deceased's medical history or attended during the fatal illness.

A doctor is not legally obliged to inform the procurator fiscal (Scotland) or the coroner (England/Wales) of any death. However, the book which contains certificates of cause of death gives advice to the certifying doctor on cases which should be notified to the medicolegal authority.

It is the legal responsibility of the registrar of births and deaths to report to the procurator fiscal or coroner, deaths which are regarded as suspicious with respect to criminality or negligence. In England the Coroner's Office has in practice extended its role to include the investigation of all deaths where the cause of death is unclear. In Scotland, the responsibility of procurators fiscal remains the investigation of deaths which are sudden, violent or suspicious, or in which the cause is unknown. Consequently, the medicolegal autopsy rate is much higher and death certificate data are considered to be more reliable in England than in Scotland.

Since the development of the International Classification of Diseases (ICD), epidemiologists have used mortality data to study trends in mortality on:

(a) cohorts within a population

(b) different populations within a country

(c) populations of different countries

These data are largely accepted and provide the basis for monitoring the state of a nation's health and the planning of health services. However, there remains a concern regarding the reliability of mortality data.

Ammendments to the procedures for selecting and coding the cause of death, particularly those made at the 6th and 8th Revisions of the International Classifications of Diseases, are thought to have led to changes in published rates of coronary mortality. The effect of converting deaths coded by the 8th Revision to the 9th Revision of ICD codes is to reduce coronary mortality rates for men and women by 7% (11).

A 1935 survey of 1032 death certificates of several countries revealed coding discrepencies of such magnitude as to invalidate comparability of national mortality statistics (12).

Other authors have studied factors which might affect the accuracy of the death certificate diagnosis. For example, Reid and Rose (13) found in 1960 that hospital doctors in America generally diagnosed coronary heart disease whilst their British counterparts diagnosed emphysema and bronchiectasis as a cause of death in test cases.

Post-mortem and clinical findings (eg ECG/cardiac enzyme) are less frequently available in cases certified by general practitioners, so the degree of inaccuracy of death certificates is thought to be higher in general practice than in hospitals (14).

Other factors believed to have contributed to the changing trends in coronary mortality include variations in the care with which death certificates are completed and differences in the coding practices of death certificate diagnoses. The use of obsolete or non-specific terminology eg myocardial degeneration create coding difficulties (10).

Difficulties in coding are greater when several disease processes are thought to be involved in the process leading to death (15).

Even where there is no doubt as to the cause of death the way in which a death certificate is worded can affect the manner in which it is coded for statistical purposes. The following example demonstates this:

Certificate 1

1.(a) Myocardial Infarction

(b) Ischaemic Heart Disease

(c) Diabetes Mellitus

2. ------

This certificate is coded to diabetes mellitus as there is a sequence that can be established from diabetes mellitus to myocardial infarction, and hence the last mentioned condition in Part 1 is chosen as the underlying cause of death. However, if the certifying practitioner enters diabetes mellitus in Part 2 as shown in the next example, the cause of death is coded to ischaemic heart disease.

Certificate 2

1.(a) Myocardial Infarction

(b) Ischaemic Heart Disease

(c) ------

2. Diabetes Mellitus

In 1987, Stehbens (16) reviewed this literature and observed that the peak in coronary mortality which occurred in western countries at the beginning of this century followed the increase in medical awareness of the pathophysiology of coronary heart disease. The apparent rise in coronary mortality was concurrent with a general decline in the mortality rates for apoplexy, renal disease and old age. Mortality data did not show similiar increases in death rates for aneurysms and cerebral vascular disease. These observations support the argument that the increase in coronary mortality may not reflect an increase in the incidence or case fatality of coronary heart disease but simply a change in fashion of the diagnosis made at death.

Coronary mortality data are compiled from deaths which occur in hospital and in the community and which, in most countries, are certified by various types of medical practitioner.

Hospital perspective

Many of the studies addressing the question of the validity of mortality statistics are based on discrepencies between ante-mortem clinical diagnosis and necropsy findings for deaths which occur in hospital. Stehbens listed 47 studies from several countries conducted between 1919 and 1985 in which the proportion of cases in which there was disagreement between clinical and necropsy diagnosis ranged from 6% to 68%.

Cameron and McGoogan (15) reviewed 5663 hospital deaths in South Lothian from 1975 to 1977. 25% of cases had a post-mortem, and were investigated in the study. Information was collected on a two part " dummy " death cerftificate. Part A was completed by the clinician and listed the diagnosis in the following way:

1 (a) the major underlying disease leading to death
  (b) conditions arising from 1(a) which were ultimately responsible for death.
2 other unrelated conditions which contributed to death.

Clinicians were was also asked to grade the accuracy of their diagnoses as: (a) certain, (b) probable, and (c) uncertain. Part B was completed in the same manner by the pathologist after autopsy.

1152 " dummy" certificates were completed, representing 80% of all the autopsies which had been carried out.

In 61% of cases the main clinical diagnosis was confirmed at autopsy. In 27% the clinical diagnosis was disproved at autopsy. In the remaining 12% of cases, the clinical diagnosis was present at autopsy but was not considered of sufficient severity to cause death in the pathologist's opinion.

False positives were most common in cerebrovascular disease where only 22% of clinical diagnoses were confirmed at autopsy, and least common in cardiovascular disease where 70% were confirmed. 33% of cardiovascular deaths diagnosed on autopsy had been missed clinically.

To complicate this picture even further a study of 182 consecutive hospital deaths in North Lothian that proceeded to autopsy found that in 43 cases (23%) the death certificate took no account of relevant findings which had been made at autopsy (17).

Community Perspective

Deaths which occur in the community are usually certified without the benefit of diagnostic information which is available to doctors in hospital. Walford (18) described the evidence available to eleven general practitioners (GPs) who certified coronary thrombosis as the cause of death in 142 cases of sudden death, defined as death that occurred before the doctor reached the patient. The GPs came from urban, suburban and rural practices. The GPs graded each certificate of cause of death as:

1. 100% accurate
2. Probably fairly accurate
3. A toss-up, no good evidence one way or another

60 cases (42%) were defined as "100% accurate". Of these 46 had been confirmed at autopsy, 13 were certified on the basis of a previous medical history of coronary heart disease (8 with a previous myocardial infarction and 5 with angina).

40 cases (28%) were defined as "probably fairly accurate". Of these 6 had a history of previous myocardial infarction and 19 a history of angina.

42 cases (30%) were defined as "a toss-up" and only one had a history of coronary heart disease.

The study showed that GPs had certified coronary thrombosis as the cause of death in 57 of 142 cases (40%) in which no necropsy had been performed and in which there was no good evidence of pre-existing coronary heart disease before death. Twenty of these deaths were witnessed but the report does not detail the descriptions of the mode of death which might have influenced the certifying GP in his choice of cause of death.

It is unclear where this study was conducted or whether the study GPs were representative of all GPs of that area. Nor does the report describe how the cases of sudden death were identified so it is not known whether the deaths investigated represent all cases of sudden death from coronary thrombosis. The results may therefore be of limited general relevance.

As part of a larger study of the process of death certification by Scottish GPs, Freer examined death certificates attributed to ischaemic heart disease (19). 268 GPs, representing a 10% random sample were sent a postal questionnaire inviting them to give details of the next death certificate which they were required to complete for patients of any age. It asked for information concerning circumstances of the death, recent medical history, and other factors that influenced their decision on the cause of death. They were also asked to assess the accuracy of their diagnosis on

a scale of 1 to 5 ranging from "not at all accurate" to "very accurate"

153 (57%) GPs returned completed questionnaires. Ischaemic heart disease was recorded as the underlying cause of death in 54 (35%) cases. The subjective accuracy ratings of the GPs were high with no death certificate rated 1 or 2.

Examination of the characteristics of the study GPs showed that doctors who had qualified within the previous five years were more likely to respond and doctors with more than twenty-five years post graduation experience were least likely to respond. Therefore the findings of this study may not be representative of GPs of all ages.

41 (76%) of the deaths were classified by the GP as sudden and 35 of these as unexpected. Analysis revealed no difference in accuracy ratings between sudden and non-sudden ischaemic heart deaths. The GPs attributed the highest accuracy ratings to deaths over the age of 75. Other studies (15,20) have shown a direct relationship between increasing age and the number of diagnostic discrepencies, which would suggest that the confidence of the GPs in this study of their diagnoses may be unfounded.

Eighteen (33%) of the doctors said that they had no supporting evidence for their diagnosis. 13 of these deaths were classified as sudden. No relationship was established between the doctor's accuracy rating and the presence or absence of supporting evidence. Six GPs (11%) felt constrained to issue a death certificate to avoid the distress to relatives which might be caused by reporting the death to the procurator fiscal.

This study provides support for the common view that cases of natural death, whether sudden or not, are often diagnosed on the basis of the GP's intutition. Myocardial infarction may be chosen as the cause of death because it is a socially acceptable cause of death and because statistics state that it is a common cause of death. In consideration of grieving relatives, the certifying doctor may use a diagnosis of coronary heart disease in order to spare them the ordeal of a police investigation, possibly including a post-mortem. The extent of this practice is not known.

At the end of the questionnaire ten GPs (19%) made general references to the inaccuracy of death certificate and mortality data. Their scepticism was not reflected in the study, which found GP subjective ratings of their accuracy high, even for the one third of cases whose death certificate diagnosis was made without any supporting evidence.

Population Perspective

A comprehensive review of death certificate practices can only be achieved by studying all coronary deaths, whether they are certified by hospital doctors, GPs or following medicolegal investigation.

Phillips (21) attempted to compare coronary mortality data in this way between the areas of Grampian Health Board and North Staffordshire Health Authority. Information was collected in each area on deaths during 1980 and 1981 in persons under the age of 60 with ischaemic heart disease (ie ICD codes 410 - 414) appearing anywhere on the certificate of cause of death.

The size of the study populations and their sex ratios were similiar. The Grampian study contained a slightly higher proportion of persons under the age of 50 and North Staffordshire a higher proportion aged 50 - 59. Both areas are served by a major hospital centre, but due to its larger geographical area, Grampian has a 113 bedded hospital in Elgin with restricted consultant services and 14 cottage hospitals under the charge of GPs. There is only one hospital with GP beds in the North Staffordshire Health Authority area.

434 Grampian deaths and 559 North Staffordshire deaths were identified with ischaemic heart disease appearing

in the list of diagnoses in the certificate of cause of death.

Information on the deaths was collected by reviewing GP records, hospital casenotes and post-mortem reports. Reports from the coroners office were available for the deaths in North Staffordshire but permission was not obtained to gain access to the records of the procurator fiscal for the deaths in Grampian. The diagnosis on the certificate was validated using W.H.O. criteria.

Hospital casenotes were available for 136 (96%) of 141 deaths in the main hospital centre in N. Staffordshire and 126 (98%) of 129 deaths in the major hospitals in Grampian.

No deaths occurred in the N. Staffordshire hospital with GP beds. GP records were obtained for 25 of the 43 deaths (58%) in the cottage hospitals in Grampian.

GP notes were available for 90% of the 559 N. Staffordshire cases. In Grampian GP notes were obtained for only 44% of the 434 cases. This discrepency was explained by the premature and unauthorised destruction of GP records of patients aged 50 - 59, in the Primary Care Department of the Grampian Health Board.

Autopsy reports were available for all 450 cases re-

ferred to the coroner in N. Staffordshire. Information on autopsy findings was not obtained for the cases investigated by the procurator fiscal in Grampian.

In 5% of the N. Staffordshire deaths and 21% of the Grampian deaths, no information could be obtained other than a copy of the certificate of cause of death. Table A shows the results of classifying deaths in each area using the W.H.O. diagnostic criteria for ischaemic heart disease.

Table A

Diagnostic Categories	Grampian	N.Staffordshire
1 - 3 Substantiated	263 (61%)	532 (95%)
4 No MI	21 (5%)	19 (3.5%)
5 Insufficient data	150 (34%)	8 (1.5%)

The authors concluded that coronary mortality data from Grampian were unreliable, and went on to question the validity of the differences in coronary mortality between Scotland and England as a whole. It is difficult to see how such a conclusion can be justified in view of the incompleteness of the investigation of the cases and the limited information which was available from GPs and certifying doctors. It is also worth noting that coronary mortality rates in Grampian are

amongst the lowest in Scotland, and for this reason, Grampian is perhaps not an appropriate area to base comparisons between England and Scotland.

A more satisfactory study was carried out by McIlwaine and colleagues in Belfast (20). Information was collected for all residents of Belfast who died during a one year period from 1981 to 1982 with ischaemic heart disease (ICD codes 410-414) as the underlying cause of death. The study also included cases in which ischaemic heart disease appeared anywhere on the death certificate, and cases in which death was attributed to cardiac dysrhythmia (ICD code 427), heart failure (ICD code 428) and ill-defined heart disease (ICD code 429). Other cases also included were those stating the cause of death as:

Part 1(a) Acute myocardial infarction

1(b) Diabetes mellitus

and coded ICD numder 250 (diabetes mellitus), and also those with:

Part 1(a) Cerebral vascular accident

1(b) Acute myocardial infarction

but coded ICD code 436 (cerebrovascular accident).

The study was designed therefore to determine the proportion of deaths which had been erroneously attributed to ischaemic heart disease (false positives) and also the proportion of deaths due to ischaemic heart

disease which had been misdiagnosed (false negatives).

Information was collected for 573 deaths, under the age of 70, from hospitals, post-mortems, the coroners office, GPs and ambulance service records. Additional information was obtained by interviewing relatives of the deceased.

Validation of the death certificate diagnoses was carried out in two stages. First, a panel of cardiologists reviewed the data collected for 498 deaths with ICD codes 410-414 and 75 with other ICD codes. 25 cases with ICD codes 410-414 were excluded and the probable diagnoses for these cases were:

Number of deaths	Probable diagnosis
10	chronic obstructive airways disease
5	rheumatic heart disease
2	pulmonary embolism
2	bronchial carcinoma
1	pulmonary oedema
1	alcoholic cardiomyopathy
1	right heart failure
1	brochopneumonia
1	pulmonary oedema
1	chronic renal failure

The following 23 cases with "other" ICD codes were included:

Number of deaths	ICD code	Diagnosis
8	428	heart failure
2	425	cardiomyopathy
1	429	ill defined heart disease
4	430-438	cerebrovascular disease
3	440-448	peripheral vascular disease
2	250	diabetes mellitus
3		misccellaneous codings.

The net effect on the official mortality statistics of excluding false positive cases and including false negative cases was neglible for persons under the age of 70 years, ie from 498 deaths certified as being due to ischaemic heart disease to 496 (-0•4%) with changes being 25 excluded (5%) and 23 added (5%).

The second stage of validating ischaemic heart disease deaths involved applying the W.H.O. diagnostic criteria for myocardial infarction to the 496 deaths considered to be due to ischaemic heart disease by the panel of cardiologists. The diagnostic categories allocated were:

1. Definite myocardial infarction
2. Possible myocardial infarction
3. Unknown - insufficient data

434 of the 496 deaths (88%) were substantiated; 128 cases (26%) were definite myocardial infarction and 306 (62%) were possible myocardial infarction. 62 deaths (12%) were classified unknown. These results by place of death are shown in Table B:

Table B

	Hospital	Community	Total
Definite	84 (45%)	44 (14%)	128 (26%)
Possible	86 (46%)	220 (71%)	306 (62%)
Unknown	16 (9%)	46 (15%0	62 (12%)
TOTAL	186 (38%)	310 (62%)	496 (100%)

The post-mortem rate was approximately the same (26%) for deaths which occurred in hospital and deaths which occurred in the community. The higher ratio of definite myocardial infarction category for hospital deaths was due to the availability of clinical data ie without post-mortem investigation, electrocardiographs (ECGs) and enzyme data are required for a "definite" category. Where post-mortem data were not available for deaths which occurred outside hospital only a small proportion (15%) were classified definite because they had been hospital in- patients during their terminal illness.

62 deaths were classified as "unknown - insufficient

data". This represents 16 hospital deaths and 46 community deaths. Unfortunately this study does not describe the characteristics of these deaths which affected their classification. For example, it is not known how many of the "unknown" hospital deaths were classified on the basis of a competing cause of death diagnosed clinically or on autopsy, or how many were classified because the diagnostic information required for the validation exercise was not obtained. Furthermore, the study does not describe to what extent this category was applied to cases with neither symptoms nor previous history of coronary heart disease for which complete data were obtained but the evidence did not meet did not meet the W.H.O. criteria for acute myocardial infarction.

The present study is similiar to the Grampian and Belfast studies as it:

(a) investigates all coronary deaths in a population certified by various types of medical practitioner with and without medicolegal investigation, and

(b) identifies the proportion of coronary deaths in which the diagnosis cannot be substantiated using standardised criteria.

Unlike the Grampian study, the present study had access to all sources of data from hospital records and pathology departments, GPs and procurator fiscal records including information on post-mortem investigation. Unlike the Belfast study, the present study relied on

existing records, eg hospital and GP casesnotes, to collect information on each cases and no interviews were conducted with relatives of the deceased. By reviewing the completeness and quality of the data obtained, an assessment is made of the reliability of coronary mortality data in Glasgow.

The approach of this study differs from previous studies, in that it relates diagnoses to the circumstances of death and the process of confirmation and certification of death eg the place of death, whether death was witnessed, the doctors involved in the process and the information which may have been available to them at the time of certification. By these means it is possible to assess the number of deaths in which the diagnosis cannot be substantiated on the basis of:

(1) unavailable information,

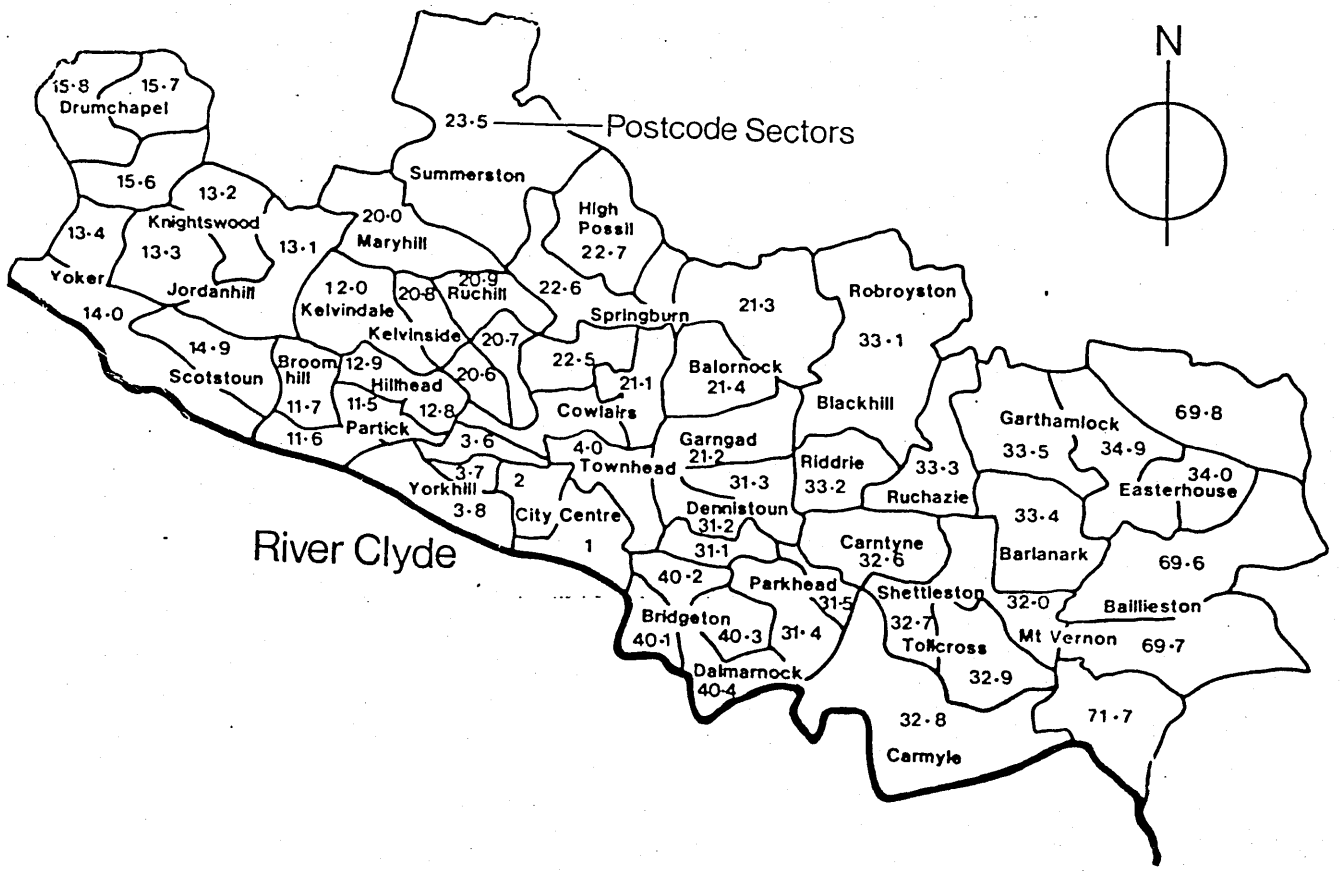
(2) evidence of a competing cause of death, or

(3) lack of clinical data to support the diagnosis.

The study assesses the likely impact on the validity of mortality data of additional information being available to the certifying doctor and discusses whether there are any measures that might be taken to improve the reliability of Glasgow's mortality data.

METHODS

The study population consists of the Glasgow MONICA population, ie persons aged 25 - 64 years resident in Glasgow, north of the River Clyde, an area which is geographically almost half of the city.



	Glasgow City	Glasgow,N of Clyde
men	153,246	95,600
women	181,437	102.600

Population figures (1981 Census, 25 - 64 years)

Ascertainment of Cases

Cases were identified from data routinely notified to the Glasgow MONICA Project. These comprise of computer printouts from the Registrar General (RG) for Scotland of all deaths in persons under the age of 65, whose normal residence is in the study population area which is defined by postcodes.

The computer printouts from the General Register Office for Scotland listing deaths during 1984 were reviewed in order to identify cases for which the underlying cause of death fell within the code range 410 - 414 of the International Classsification of Diseases, 9th Revision (ICD). These rubrics contain the following diagnoses:-

410	Acute myocardial infarction
411	Other acute and subacute forms of ischaemic heart disease
412	Old myocardial infarction
413	Angina pectoris
414	Other forms of chronic ischaemic heart disease

In order to assess the completeness of the RG data the cases were cross-referenced against the following sources of information:

1. Computer printouts, provided by the Computing Department of the Western Infirmary Glasgow of Scottish Hospital Morbidity Data (SMR1) of all fatal and non-

fatal cases discharged from hospital with diagnoses of ischaemic heart disease (ICD codes 410 - 414) for residents in the study population.

2. Responses of postal questionaires to general practitioners (GPs) requesting details of any death from coronary heart disease of a resident in the study population who died abroad ie whose death may not come to the attention of the RG.

In addition to the above sources Mr Carmichael, Depute Procurator Fiscal, for the duration of this study sent copies of procurator fiscal reports for all coronary heart disease deaths occurring in residents of Glasgow, north of the River Clyde, under the age of 65.

A copy of the D Death Scotland form (see Appendix 2) was supplied by the RG for each case for which the cause of death was listed ICD code 410-414. For the purposes of this study the form contains the folllowing information:

- name
- address
- sex
- date of birth
- date and time of death
- place of death
- causes of death
- name and address of GP and certifying doctor

Investigation of Cases

Each case was investigated systematically in order to ascertain :

1. the circumstances of death, (eg where death occurred, whether death was witnessed, medically attended etc), and
2. the medical and legal agencies involved in the process of confirmation and certification of the death, and
3. clinical data (ie symptoms, electrocardiograph (ECG) and cardiac enzyme results and post-mortem findings), and
4. the previous medical history.

1st stage of the investigation

The records of the Glasgow Death Unit in the Procurator Fiscal Office were examined to identify those deaths in the study population which had been notified to the procurator fiscal. In some instances, usually on the basis of a telephone call from the GP or hospital doctor, the procurator fiscal records on a Notification of Death Form a brief account of the circumstances of the death with or without some details of the previous medical history and proceeds no further (Appendix 3). In other cases the procurator fiscal may iniate a fuller investigation, involving interviews with witnesses of the death, and/or the deceased's relatives and GP, This investigation is conducted by the police on behalf of

the procurator fiscal in order to satisfy legal and not medical requirments. The Police Report of Sudden Death provides an account of the circumstances of the fatal event and gives details of the previous medical history including hospital admissions (Appendix 4). Both the Notification of Death Form and the Police Report of Sudden Death indicate whether a post-mortem investigation was performed.

2nd stage of investigation.

Hospital casenotes and Accident and Emergency (A&E) department records were examined for all cases in which a hospital had been recorded as the place of death on the D Death Scotland Form and for all cases reported to the procurator fiscal which had received hospital treatment within 28 days prior to death.

3rd stage of the investigation.

Hospital mortuary records were examined in order to ascertain whether a post-mortem investigation had been performed for cases which had a hospital recorded as the place of death on the D Death Scotland Form, some of whom died in hospital, and others of whom were dead on arrival at hospital (DOA). Most cases of death on arrival are taken to the city mortuary but a few are admitted to the hospital mortuary.

4th stage of investigation

Information from GPs was requested only if complete information concerning the circumstances of death and previous medical history was not obtained from the above sources. For example, if the death occurred outside hospital and was not referred to the procurator fiscal, details of the fatal event and previous medical history were requested from the GP or certifying doctor by means of a postal questionaire (Appendix 5). If a GP or certifying doctor was unable to complete the questionaire for any reason, permission was sought from the GP to access the deceased's medical notes once they had been returned to the Primary Care Department of Greater Glasgow Health Board (see Appendix 6). Hospital records were reviewed if the GP indicated that the deceased had received hospital treatment within 28 days prior to death.

In the event of a death of a resident of the study population occurring outside the jurisdiction of the procurator fiscal for Glasgow or in a hospital outside Glasgow similiar enquiries were made of the appropriate medico/legal authorities and records departments requesting access to all relevent documentation concerning the case.

Definitions Used

Definitions recommended by the W.H.O. MONICA protocol were used to establish the presence of symptoms and the time and place of death. Symptoms were recorded if there was a manifestation of an acute illness within 28 days preceding death, not the onset of mild indefinite symptoms. The time of death was recorded as the time at which the fatal collapse was thought to have occurred. Similiarly the place of death was considered as the place where the irreversible cardiac arrest occurred. (See Footnote to this chapter)

Data handling and analyses

I joined the Glasgow MONICA Project team in August, 1983 which at that time consisted of the then Head of Project, Dr Graham Watt and a Project secretary. Together with Dr Watt, I was involved in pilot studies designed to establish the most efficient means of obtaining data. These methods are incorporated in a manual of operations for the Glasgow MONICA Project. With the aid of this manual I have been the key person involved in training the staff of the Glasgow centre which now consists of a part-time Project Head, a secretary, 4 clerical officers and 3 research nurses.

In addition to the collection of a core data set of basic information for international comparison, required by the W.H.O. MONICA protocol, the Glasgow MONICA

Project records additional items of information which are available from routine sources and which might allow further analyses of local interest. These additional items are highlighted on the Glasgow MONICA Coronary Event Registration Record Form (Appendix 7).

The period investigated in this study includes the 9 month period immediately preceding the formal start of the Glasow MONICA Project on 1 October, 1984. These data from the early part of 1984 were collected when methods for the ascertainment and investigation of cases were being piloted. For this reason many of the data collection and coding procedures were carried out by other staff of the Glasgow MONICA Project Centre. Each case has been subsequently reviewed by myself in order to check that data have been recorded reliably from the original sources, and that the MONICA diagnostic codes are also reliable.

Personal details such as names and addresses were recorded initially in order to cross reference cases during data collection. These data were subsequently removed and each case was given a unique identification number.

Subsequently I reviewed the documents for each case in order to identify and record additional information not recorded on the MONICA Registration Record. For exam-

ple, it does not record whether cases which die in the community are transported to hospital. Nor does the information recorded on the MONICA Registration Form indicate whether cases certified by a forensic pathologist had been seen previously by a GP and/or hospital doctor and/or police casualty surgeon. Most of this enhancement of the MONICA dataset was based on review of police and procurator fiscal reports.

Death certificate diagnoses were validated using W.H.O MONICA criteria for myocardial infarction based on symptoms, ECG and cardiac enzymes results , past medical history and post-mortem findings. There are 5 MONICA diagnostic categories:

1. Definite Acute Myocardial Infarction
2. Possible Acute Myocardial Infarction
3. Ischaemic Cardiac Arrest
4. No Acute Myocardial Infarction
9. Fatal Cases with Insufficient Data

The Definite Acute Myocardial Infarction Category requires ECG evidence of acute myocardial infarction, and/or symptoms, cardiac enzyme results or post-mortem findings of acute myocardial infarction.

The Possible Acute Myocardial Infarction Category is applied to cases with:

(a) symptoms of myocardial infarction with/without ECG or enzyme results of non-acute coronary heart disease or

to cases without symptoms of myocardial infarction or evidence of rheumatic heart disease or cardiomyopathy but with (b) post-mortem findings coronary disease or (c) a previous history of coronary heart disease.

The Ischaemic Cardiac Arrest Category is applied to survivors of cardiac arrest whose symptoms, ECG and enzyme results do not qualify for either diagnostic category 1 or 2.

The No Myocardial Infarction Category is applied to cases without symptoms, ECG, enzyme of myocardial infarction or where another diagnosis has been made clinically or on post-mortem.

The Fatal Case with Insufficient Data Category is applied to cases with insufficient data available to apply any of the above categories.

(NB The Diagnostic Criteria and Classification of Coronary Events as defined in the W.H.O MONICA Memo 30 are shown in Appendix 9.)

Using the Glasgow MONICA Sirius data entry and checking programmes I entered the data for the first 9 months of the study on to floppy discs. The remaining 3 months of data were keyed by others as part of the routine work of the MONICA Project. KERMIT, a file transfer protocol, was used to transfer the files from the floppy discs on to the mainframe computer of the University of Glasgow.

Cross-tabulations, were performed using the Statistical Package for Social Sciences (SPSS-x). Subsequent analyses of information not recorded on the MONICA Coronary Registration Record Form were carried out manually.

Statistical analyses of the 2 X 2 tables of results were carried out using Chi Square test with Yates continuity correction. Where the numbers were small Fishers exact probability test was used.

Footnote to Definitions Used.

The date, time and place of death are often recorded on the D Death Scotland form as the times and place where the person was first medically examined and certified dead. For example, a person who dies outside hospital or in transit to hospital may have the hospital recorded as the place where death occured if this was the place in which the deceased was first medically examined and certified dead. Similiarly, the time of death is often recorded as the time the deceased person was first medically examined although the actual death might have occured some time previously. In some cases, however the certifying doctor may try to record these items more accurately based on the evidence available. Factors that may be considered would include accounts of the terminal event by witnesses and/or evidence of rigor mortis or post-mortem staining on examination.

AVAILABILITY OF DATA

1562 deaths from all causes occurred in the study population during 1984. In 420 cases the underlying cause of death was ischaemic heart disease (ICD codes 410 - 414) .

One additional death from coronary heart disease was identified from the procurator fiscal (fiscal) records which had been diagnosed by a forensic pathologist following post-mortem investigation. This death appeared in the RG data coded to ICD rubric 485 (bronchopneumonia) and was not included in the study as it is not contained in the official statistics that give Glasgow its high mortality rates.

No additional cases of coronary death were identified from SMR1 computer printouts (based on hospital discharge data) during 1984 or from a postal questionnaire to Glasgow GPs seeking information on patients who may have died abroad ie cases which might not be contained in the RG data.

Documentation Obtained

Relevant sources were consulted for the 420 cases, in order to collect information about the circumstances of death, the medical and legal agencies involved in the certification process, the available clinical data and the previous medical history. When complete information was obtained from a source, or a combination of sources, other sources were not investigated. For example, GP records were only consulted if the relevant

information was not documented in hospital or fiscal records. Table 1 summarises the documentation obtained.

Examination of the records of fiscal revealed that they had been notified of 269 of the study deaths. For 32 cases only copies of the Notification of Death Form were obtained . For 237 cases copies of the Police Report of Sudden Death were obtained; for 117 of these cases copies of the forensic pathologists' post-mortem reports were available. Fiscal records could not be found for only one case which the GP intimated had been reported to the fiscal. Hospital Accident and Emergency (A&E) notes were found for this patient who was dead on arrival at hospital (DOA). The GP notes were also consulted to obtain details of the previous medical history.

Hospital casenotes were reviewed for 113 patients who died in a hospital ward and for two who died in an A&E department, both of whom had been in-patients within nine days prior to death. Hospital casenotes were also reviewed for another two cases who were dead on arrival at hospital. One case had been discharged from hospital 15 days prior to death and the other had been admitted direct to a coronary care unit (CCU) where resuscitation attempts lasted 2 hours.

Copies of hospital post-mortem reports were obtained for all 23 cases which had post-mortem investigation on

Table 1 Sources of information on cases according to the place of death.

Place of death	Community	Abroad	D.O.A.	A&E	Wards	Hospital Workers	Unknown	TOTAL
No. of deaths	205	1	90	8	113	2	1	420
Fiscal notification forms	8	-	5	3	17	-	-	33
Fiscal Police reports	135	1	82	4	13	2	-	237
Fiscal Post-Mortem reports	54	1	48	1	11	2	-	117
Hospital casenotes	12*	-	2	2	113	-	-	129
Hospital A&E notes	2	-	5	8	-	-	-	15
Hospital Post-Mortem reports	-	-	3	1	19	-	-	23
GP notes	61	-	2	-	-	-	1	64

* 2 = 1 hospital out-patient records + 1 record of a hospital domiciliary visit

Abbreviations D.O.A. = Dead on arrival at hospital
A&E = Accident and emergency department

behalf of the hospital clinician.

Information on deaths in the community was supplemented by reviewing the hospital records of ten cases who had been discharged from hospital within three weeks prior to death. Other hospital records including ECGs were obtained for a further two cases; one had attended a clinic eleven days prior to death and the other had a domiciliary hospital consultant visit on the day preceding death.

The records of hospital A&E departments were obtained for the 8 patients who died in these departments but for only 4 of the 10 cases who were dead on arrival at hospital and who were known (from fiscal reports) to have had cardiopulmonary resuscitation attempted on arrival at the hospital; records for the other 6 patients were not found. A&E records were reviewed for 2 cases of death in the community which had attended these departments during the week prior to death.

Information was collected on all but one of 62 cases which were certified by a GP without referral to the fiscal, either from the GP notes if they had been returned to the health board or from a postal questionnaire to the GP. In the remaining case no information consulted for a patient who was dead on arrival at a hospital in Surrey, in order to clarify details of the patient's medical history.

In one case, certified without referral to the fiscal, it was not possible to determine the place of death. The death certificate had been signed by a hospital doctor and the hospital recorded as the place of death on the D Death Scotland Form. However no hospital casenotes or A&E records could be located for this case. The GP notes for this patient were reviewed in order to obtain details of the previous medical history.

By these means information on the cicumstances of death, agencies involved in the certification process, clinical data and previous medical history was collected for all but one of the 420 deaths. For this case the only documentation available was a copy of the D Death Scotland Form.

Completeness of Documentation Obtained

Virtual complete ascertainment of information was obtained so that:

- the place of death was known for 419 cases
- reports from the fiscal were obtained for 269 of 270 cases where this information was expected.
- post-mortem reports were obtained for all 140 cases which had post-mortem investigation; 22 on behalf of the hospital clinician, 117 on behalf of the fiscal and 1 which was requested by both the fiscal and the hospital clinician.

- ECG/enzyme results were available for 86 of 123 cases which died in hospital and 12 which died in the community.
- information on symptoms during the 28 days preceding death was available for 277 cases (including some unwitnessed deaths). 143 cases had no documented information on symptoms prior to death; 94 cases (66%) were unwitnessed and therefore might have had symptoms preterminally. In 21 cases (15%) it was not documented whether death had been witnessed. The remaining 28 deaths (19%) were witnessed, but the records contained no information concerning symptoms prior to death.
- details of previous medical history were obtained for 404 cases; 205 had a previous medical history of coronary heart disease, 199 had no previous history and in 16 cases the records contained no information concerning the previous medical history.

VALIDATION OF DEATH CERTIFICATE DIAGNOSIS

Validation of the Death Certificate Diagnosis

The W.H.O MONICA criteria for acute myocardial infarction were used to categorise 420 deaths certified due to ischaemic heart disease in the study population.

Table 2 summarises the categorisation of deaths, using the MONICA criteria and also according to the type of certifying doctor.

110 deaths (26%) were categorised as "definite acute myocardial infarction", 253 (60%) as "possible myocardial infarction", 17 cases (4%) as "no myocardial infarction" and 40 (10%) as "unknown".

Substantiated Death Certificate Diagnoses

112 deaths of hospital patients (93%) and 251 community deaths (84%)* were substantiated by the W.H.O MONICA criteria for myocardial infarction ie "definite" or "possible myocardial infarction". The proportion of deaths categorised as "definite myocardial infarction" was greater for deaths which occurred in hospital, 45% (55 of 121 deaths) compared with 18% (55 of 298 deaths) which occurred in the community.

* The community death rate includes the deaths of 2 hospital workers because they received hospital treatment only after cardiac arrest had occurred.

Table 2 Classification of death certificate diagnoses using W.H.O. MONICA criteria for myocardial infarction in relation to the certifying doctor.

Type of Certifying Dr.	Substantiated Diagnoses (%)	Unsubstantiated Diagnoses		Total No. of Cases Certified (%)
		No M.I. (%)	'Unknown' (%)	
GP	69 (75%)	2 (2%)	21 (23%)	92 (22%)
A&E Dr.	10 (91%)	0	1 (9%)	11 (3%)
Hospital Dr. (ward)	98 (92%)	8 (8%)	0	106 (25%)
Hospital Pathologist	1 (100%)	0	0	1
Police Casualty Surgeon	39 (87%)	0	6 (13%)	45 (11%)
Forensic Pathologist	146 (89%)	7 (4%)	12 (7%)	165 (39%)
TOTAL	363 (86%)	17 (4%)	40 (10%)	420

49 of the 55 "definite myocardial infarction" community deaths (89%) were categorised on the basis of post-mortem evidence of myocardial infarction. The remaining 6 deaths (11%) were categorised "definite" on the basis of diagnostic information available from hospital records for recent admissions associated with the terminal event.

15 of the 55 "definite myocardial infarction" hospital deaths (27%) were categorised on the basis of post-mortem evidence. The remaining 40 deaths (73%) were categorised "definite" due to the availability of hospital clinical data.

Death Certificate Diagnoses Not Substantiated

57 cases did not meet the criteria for "definite" or "possible" myocardial infarction; 4 were categorised "unknown" because complete documentation was not obtained. In the remaining 53 cases, 36 were classified "unknown" and 17 as "no myocardial infarction", the MONICA diagnostic conclusion was not affected by the availability of records.

Table 3 summarises the classification of these 53 cases in relation to the type of certifying doctor; 21 (40%) were certified by GPs, 8 (15%) by hospital doctors, 5 (9%) by police casualty surgeon (PCS)s and 19 (36%) by forensic pathologists.

Table 3 Classification of cases with diagnoses which could not be substantiated using W.H.O. MONICA criteria for myocardial infarction in relation to the type of certifying doctor.

Type of Certifying DOCTOR	No. of Cases Certified	NO MYOCARDIAL INFARCTION			"UNKNOWN"	Total No. of Cases Not Substantiated	% Of Cases Certified
		Cases with a Competing Cause of Death		Cases with History of 'OTHER' Heart Disease	No symptoms, ECG/ enzyme, PMH or post-mortem evidence		
		CLINICAL	POST-MORTEM				
GP	92	-	-	2	19	21	23
Hospital Dr. (A&E)	11	-	-	-	-	-	-
Hospital Dr. (ward)	106	2	3	3		8	8
Hospital Dr. (pathologist)	1	-	-	-	-	-	-
Police Casualty Surgeon	45	-	-	-	5	5	11
Forensic Pathologist	165	-	6	1	12*	19	12
TOTAL	420	2	9	6	36	53	13

* 2 certified following post-mortem, however due to advanced decomposition the results were inconclusive

NB The "Unknown" Category was also applied to 4 cases for which full documentation was not obtained.

No Myocardial Infarction Category

8 of the 17 cases (47%) categorised "no myocardial infarction" had post-mortem investigation which revealed an alternative cause of death. 7 cases had an alternative diagnosis linked with a diagnosis of coronary heart disease in the underlying cause of death section of the certificate. For example:

1 (a) Peritonitis
  (b) Ischaemic heart disease
  (c) .....
2 .....

(NB The selection of ischaemic heart disease as the underlying cause of death does not meet the coding criteria of the Registrar General as no logical sequence can be established between ischaemic heart disease and peritonitis.)

In the remaining case the pathologist suggested a change in the death certificate diagnosis of ischaemic heart disease to acute alcohol intoxication.

In a further case no alternative cause of death was found at post-mortem, but the degree of the coronary heart disease found at post-mortem did not meet the W.H.O criteria for death due to definite/possible myocardial infarction.

In 2 of 8 the cases which did not proceed to post-mortem investigation the cause of death on the certificate did not agree with the clinical diagnosis made by the hospital doctor; 1 death was clinically diagnosed due to pulmonary embolism and the other due to cardiac failure. In both cases the death certificate had not been completed by the same doctor who had written the hospital discharge summary.

In the remaining 6 cases that did not proceed to post-mortem, insufficent account was taken of a previous medical history of valvular heart disease or cardiomyopathy as a competing cause of death. In 2 of these cases there was no information recorded concerning symptoms prior to death; 1 death was unwitnessed and so information would only be available if symptoms had been noted earlier in the 28 day period before death. In the other case it was not documented whether death had been witnessed.

7 of the cases with "unsubstantiated" diagnoses certified by GPs had been notified to the fiscal who did not request post-mortem investigation, ie the GP and fiscal had presumably agreed on the diagnoses. In 4 cases death had been confirmed by a GP/DDS doctor and 2 had been confirmed dead on arrival at hospital. The remaining death had been confirmed by a police casualty surgeon who declined to certify.

Unknown Category

For 10 cases (28%) which were categorised "unknown" the information concerning symptoms, past medical history or post-mortem was available but did not meet the criteria for myocardial infarction. For example, one case was certified by a forensic pathologist followed post-mortem examination but due to advanced decomposition the post- mortem findings were inconclusive.

In the remaining 26 cases (72%) which were categorised "unknown", the relevant documents were obtained but contained insufficient information about symptoms to support a diagnosis of coronary heart disease. In 16 cases death was unwitnessed and information on symptoms could only have been available if symptoms had been noted earlier in the 28 day period before death. In 4 cases death had been witnessed but there was no record of symptoms prior to death. In the remaining 6 cases it was not recorded whether death had been witnessed. If this information had been recorded it may have affected the MONICA classification.

Summary to Validation of Death Certificate Diagnosis

420 deaths in the study population were categoriesed using the W.H.O. MONICA criteria for myocardial infarction. 86% of coronary death certificates' diagnoses were substantiated ie classified "definite" or "possible" myocardial infarction. There was a higher ratio of "definite" cases for deaths which occurred in hospital.

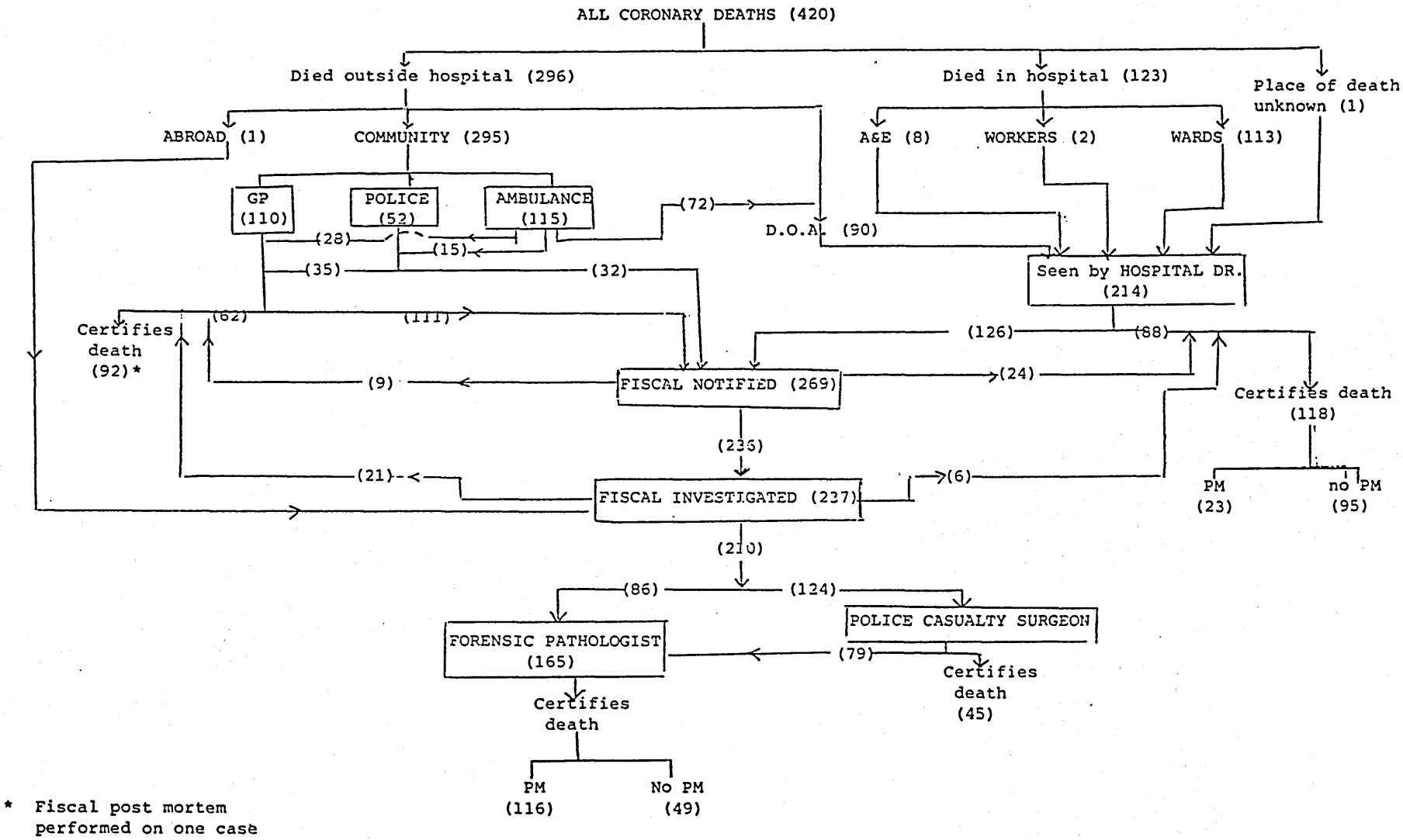
17 (4%) cases were classified "no myocardial infarction"; in 3 of these cases the diagnosis was different from that on the death certificate. In another 7 cases, an alternative cause of death had been diagnosed in persons with co-existing coronary heart disease but, due to errors in listing the diagnoses on the certificate the coronary disease diagnosis was selected and coded as the underlying cause of death. 1 case had post-mortem evidence of coronary heart disease but the evidence did not meet the MONICA criteria. In the remaining 6 cases, insufficent account was taken of pre-existing valvular heart disease or cardiomyopathy as a competing cause of death.

40 (10%) cases were categorised as "unknown" on account of insufficient data. In 4 cases relevant documents could not be obtained. In a further 26 cases, information concerning symptoms prior to death was not recorded and these missing data might have affected the

categorisation. In the remaining 10 cases for which relevant records were obtained and the information recorded was complete, there was no evidence to support the diagnosis made at death.

HOW CORONARY DEATHS WERE CERTIFIED

FIGURE 1 The process of confirmation and certification of coronary deaths in the study population



* Fiscal post mortem performed on one case

Abbreviations D.O.A. = Dead on arrival at hospital
A&E = Accident and emergency department

How coronary deaths were certified

The flow diagram (Figure 1) illustrates the process of death certification for 420 deaths in the study population attributed to coronary heart disease. It shows in relation to the place of death, the various pathways involving medical and legal systems through which deaths proceed to certification.

296 deaths (70%) occurred outside hospital; 90 cases were conveyed to hospital where death was confirmed, 1 death occurred in a resident of the study area whilst abroad on holiday and 205 deaths occurred in the community and were not conveyed to hospital. GPs and doctors from the doctors deputising service (DDS) were first in attendance in 110 cases and a further 63 were referred to them by the police and the ambulance service. The GP/DDS doctor certified 62 of the cases which came to their attention without notifying the fiscal.

214 cases had death confirmed by a hospital doctor. These include the deaths of 113 hospital in-patients, 8 deaths in hospital A&E departments, the deaths of 2 hospital workers at their place of work and 90 cases which were dead on arrival at hospital. Hospital doctors certified 88 cases without notifying the fiscal.

Fiscals were notified of a total of 270 cases; 111 were referred by GPs/DDS doctors, 126 by hospital

doctors, 32 by the police and 1 (who had died abroad) by the local registrar for births and deaths. In 237 cases police investigation was conducted on behalf of the fiscal before certification. The remaining 33 cases were referred by the fiscal to the hospital doctor or GP/DDS doctor for certification without investigation.

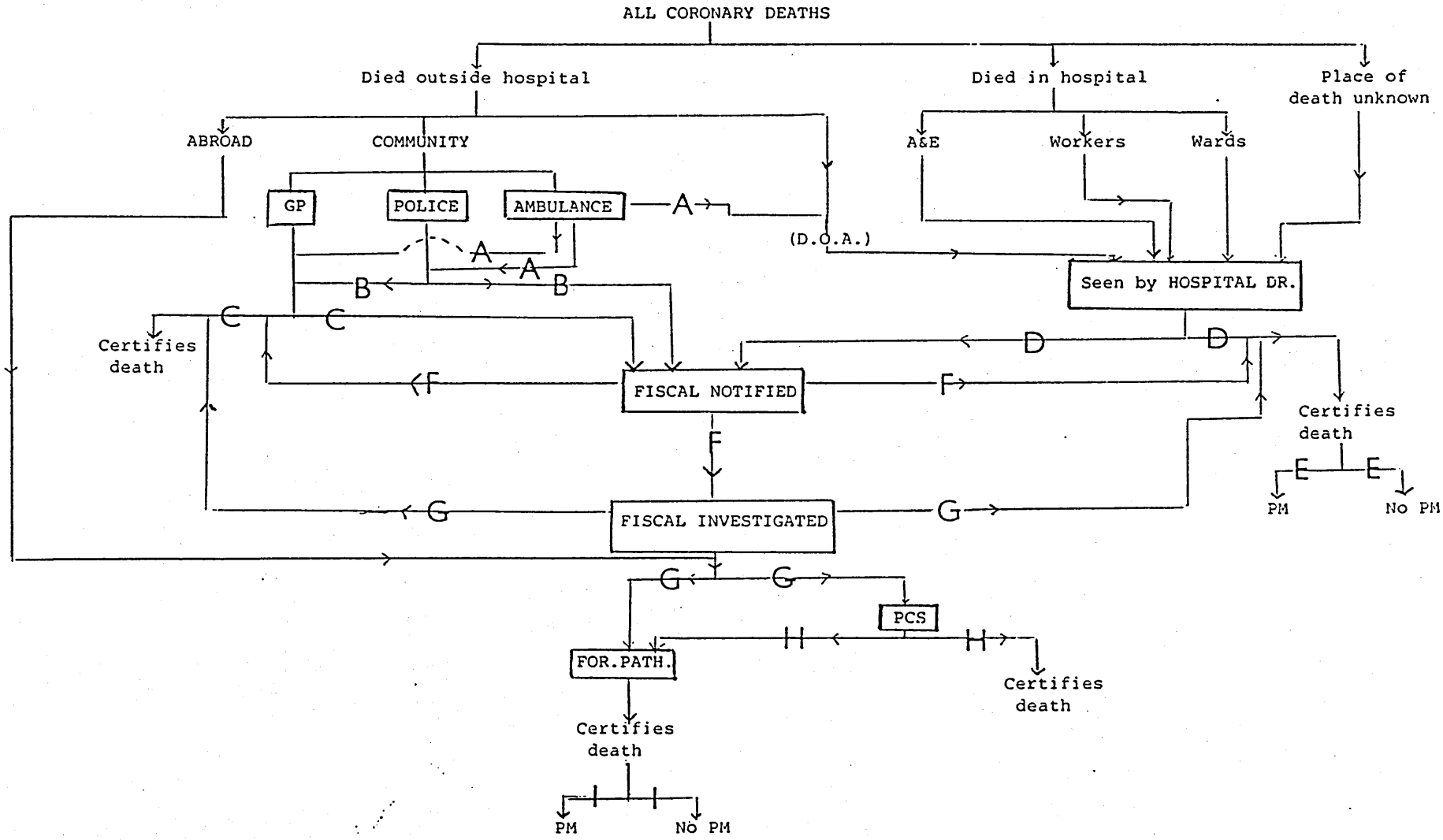
21 cases investigated by the police were referred by the fiscal to a GP and 6 to a hospital doctor for certification. Of the remaining 210 cases, 124 were referred to a PCS who certified 45 and referred 79 to a forensic pathologist.

Forensic pathologists saw 166* cases and issued a death certificate for 49 (30%) without carrying out a post-mortem examination.

The highlighted areas of Figure 2 show key decisions in the processes leading to certification of death. For example, decisions were made by ambulance crews whether to convey a subject to hospital or leave the deceased at the place of death and notify the GP or the police.

(*1 case certified by a GP had a "fiscal" post-mortem)

FIGURE 2 Key decision points in the processes leading to certification



Abbreviations D.O.A. = Dead on arrival at hospital
A&E = Accident and emergency department

The subsequent text focuses on the types of person making these decisions (Figure 2, Decision Points A-I) and describes the decisions in relation to:

(a) the place of death

(b) whether death was witnessed

(c) the presence of clinical information

(d) previous medical history.

The following questions are addressed at-

Decision Point A.

What factors influence decisions made by ambulance crews to:

1. convey a body to hospital or leave it at of death?
2. refer cases to the GP or to the police?

Decision Point B.

What factors influence decisions made by the police to:

1. refer a case to the fiscal or the GP?

Decision Point C.

1. What factors influence decisions by GPs to refer a case to the fiscal or to certify without referrral to the fiscal?
2. What is the evidence for the diagnosis of coronary heart disease for deaths certified by GPs without referral to the fiscal?

Decision Point D.

1. What factors influence decisions by hospital doctors to refer a case to the fiscal or certify death without referral to the fiscal?

Decision Point E

1. What factors influence decisions by hospital doctors to request post-mortem investigation, or to certify death without post-mortem investigation?
2. What is the evidence for the diagnosis of coronary heart disease for deaths certified by hospital doctors?

Decision Point F.

1. What factors influence decisions by the fiscal to instigate a police investigation concerning the circumstances of death and previous medical history, or to refer the case to a doctor for certification without investigation?

Decision Point G.

1. What factors influence decisions by the fiscal to refer a case to a forensic pathologist for possible post-mortem investigation, or to refer the case to a doctor for certification without post-mortem investigation?

Decision Point H.

1. What factors influence decisions by PCSs to issue the death certificate, or to refer the case to a forensic pathologist.
2. What is the evidence for a diagnosis of coronary heart disease for deaths certified by PCSs?

Deciion Point I.

1. What factors influence decisions by forensic pathologists to certify death following external examination only, or following post-mortem investigation?
2. What is the evidence for the diagnosis of coronary heart disease for deaths certified by the forensic pathologist?

A. Possible decisions by ambulance crews on attending a person who has had a cardiac arrest

Introduction.

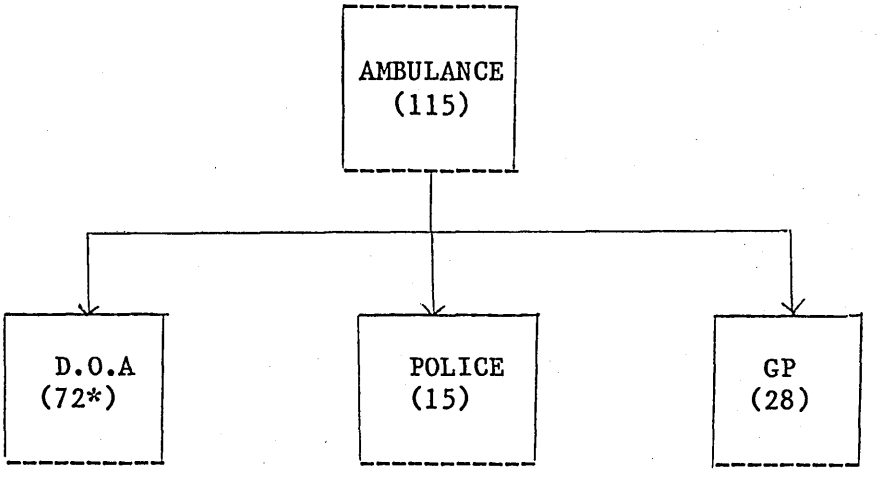
On attending a person who has had a cardiac arrest prior to their arrival, the ambulance crews has the following options:-

(1) to convey the deceased to hospital or to leave the deceased at the place of death,

(2) to notify the police authorities, or

(3) to inform the deceased's GP.

The diagram below illustrates these possible decisions by ambulance crews in relation to the study deaths.



The ambulance service attended a total of 115 cases, 90 men (78%) and 25 women (22%), that were known to have sufffered cardiac arrest prior to their arrival. 72 (63%) cases were conveyed to hospital and 43 (37%) were not conveyed to hospital.

A. Decisions by ambulance crews

* A total of 90 cases were confirmed dead on arrival at hospital. These include: 72 cases contained in the following analyses, 5 cases who had cardiac arrest in the ambulance ie were alive when uplifted by the ambulance, 8 cases for which it was not possible to determine whether death occurred in transit, 2 cases (1 in Surrey and 1 in Aberdeen) for which details of the mode of transport could not be obtained and, 3 cases where the deceased was conveyed to hospital in a vehicle other than an ambulance (1 taxi, 1 police car and 1 private car).

There were no age or sex differences between cases which were conveyed or not conveyed to hospital by the ambulance service.

Table A.1 describes the decision taken by ambulance crews to convey the deceased to hospital, in relation to whether or not the death was witnessed. Death had been witnessed in 47 cases (65%) which were conveyed to hospital compared with 25 cases (58%) which were not conveyed to hospital. The difference is not statistically significant ($p>0{\cdot}05$).

A. Decisions by ambulance crews

Table A.1 Breakdown of deaths attended by the ambulance service by witness to death and whether taken to hospital.

	Witnessed	Not Witnesssed	Total
Taken to hospital	47	25	72
Not taken to hospital	25	18	43
Total	72	43	115
% Taken to hospital	65	58	62

A. Decisions by ambulance crews

Table A.2 describes the decision taken by ambulance crews to convey the deceased to hospital in relation to the place of death. 46 of 51 cases (90%) which died outside their home address were conveyed to hospital whereas only 38 of the 64 cases (41%) which died at home were taken to hospital. The difference is statistically significant ($p < 0{\cdot}001$)

Table A.3 describes the decision taken by ambulance crews to convey the deceased to hospital in relation to whether death occurred suddenly ie without recorded symptoms of any nature prior to death. 18 of the 45 cases (40%) with symptoms preceding death were taken to hospital by the ambulance. 28 of the 34 cases (82%) with no evidence of symptoms before death were taken to hospital by the ambulance. The difference is statistically significant ($p < 0{\cdot}001$)

Of the 43 cases not conveyed to hospital by ambulance, 28 (65%) were referred to the GP and 15 (35%) were referred to the police. No differences could be identified between these cases with respect to age, sex, suddenness of death or whether death was witnessed.

A. Decisions by ambulance crews

Table A.2 Breakdown of deaths attended by the ambulance service by place of death and whether taken to hospital.

	Death at Home	Death Elsewhere	Total
Taken to hospital	26	46	72
Not taken to hospital	38	5	43
Total	64	51	115
% Taken to hospital	41	90	62

Null Hypothesis

There is no association between the decision to transport a case to hospital and the place of death.

$x^2 = 27{\cdot}71$, 1 d.f., $p < 0{\cdot}001$

Conclusion:

The hypothesis is rejected.

Comment:

There is probably an association between the decision to transport a case to hospital and the place of death.

A. Decisions by ambulance crews

Table A.3 Breakdown of deaths attended by the ambulance service by presence of symptoms preceding death and whether taken to hospital

	Symptoms	No Symptoms	No Data	Total
Taken to hospital	18	28	26	72
Not taken to hospital	27	6	10	43
Total	45	34	36	115
% Taken to hospital	40	82	72	62

Null hypothesis

There is no association between the decision to transport a case to hospital and the presence of recorded symptoms, of any nature, prior to death.

$x^2 = 14{\cdot}59$, 1 d.f., $p < 0{\cdot}001$

Conclusion:

The hypothesis is rejected.

Comment:

There is probably an association between the decision to transport a case to hospital and the presence of symptoms prior to death.

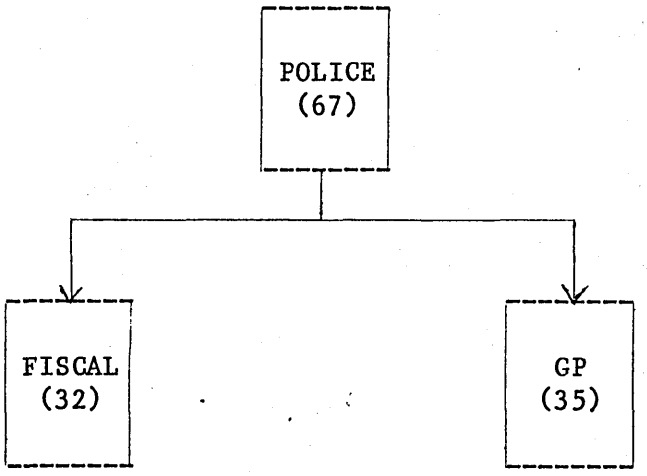
B. Possible decisions by the police

Introduction

On attending a case of death in the community, the police has the option of referring the case for confirmation of death to the:-

1. GP or
2. the police casualty surgeon and thereby the fiscal.

The diagram below illustrates these possible decisions by the police in relation to the study deaths.



The police were involved in 67 deaths which were not taken to hospital. In 52 cases (78%) the police were first in attendance. The other 15 deaths (22%) were referred to the police by the ambulance service. 35 deaths (52%) seen by the police were referred to the patient's GP or a DDS doctor. 32 deaths (48%) were referred to the fiscal.

There were no differences between cases referred by the police to the GP/DDS doctor or to the fiscal with respect to age, sex, symptoms or area of residence.

B. Decisions by the police

Table B shows the referral rate to the fiscal by the police in relation to the place of death. 28 of 62 deaths (45%) which occurred at home compared with 4 of 5 deaths (80%) which occurred outwith the deceased's normal residence were referred to the fiscal by the police. The police seemed more likely to refer cases to the fiscal if death occurred outwith the deceased's normal residence. However, the number of these deaths was small and the difference is not statistically significant.

In some cases, the available information showed other possible reasons for the decision taken by the police. For example, in 5 cases (7%) the police reported evidence of bruising or abrasions on the body; 1 case was referred to the GP and 4 to the fiscal. 8 deaths (12%) were referred to the fiscal because the GP could not be contacted or because the identity of the GP was not known. 1 death reported to the fiscal followed a family argument. In 2 cases (4%) the deceased had been a victim of a criminal assualt within 2 months prior to death; one case was referred to the GP and the other was reported to the fiscal. The police were obliged to force entry into the deceased's home in 2 cases, one death was reported to the fiscal and the other to the GP. One death reported to the fiscal occurred in a man who had been discharged from a hospital A&E Department one hour prior to death.

B. Decisions by the police

Table B. Breakdown of cases seen by the police by place of death and whether referred to the fiscal

	Death at Home	Death Elsewhere	Total
Referred to Fiscal	28	4	32
Referred to GP	34	1	35
Total	62	5	67
% Referred to Fiscal	45	80	48

Null hypothesis

There is no association beween the decision to refer a case to the fiscal and the place of death.

$p = 0{\cdot}151$ Result not significant

Conclusion:

The hypothesis is accepted.

Comment:

There is probably no association between the decision to refer a case to the fiscal and the place of death.

C. Possible decisions by the General Practitioner

Introduction

Doctors in the community, ie GPs, DDS doctors and other doctors outside a hospital, were involved with 173 deaths which occurred in the community and which were not taken to hospital. 3 deaths (2%), two at work and one at a football stadium, were first attended by a doctor other than the patients own GP or doctor from the DDS and these cases were referred to the fiscal. The subsequent text focuses on the possible decisions taken by GPs (ie GPs and DDS doctors) in the remaining 170 cases.

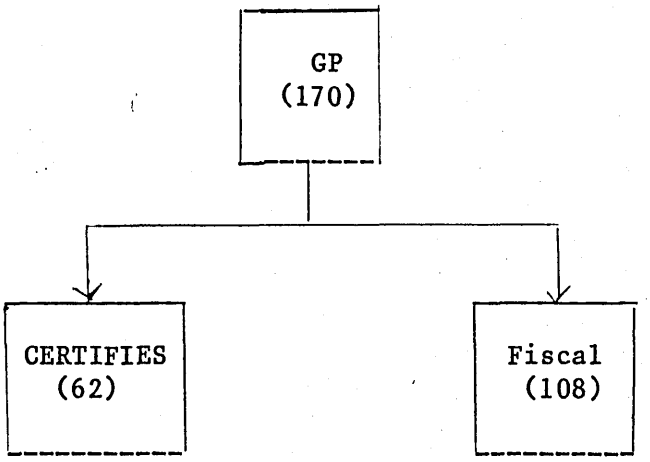
GPs had the the following possible options on attending a case of death in the community:-

(1) to certify death without notifying the fiscal, or

(2) to notify the fiscal of the death for possible police investigation.

The diagram below illustrates these possible decisions by GPs in relation to the study deaths.

C. Decisions by the General Practitioner



The GP was the first person in attendance in 107 (63%) of the deaths; 28 deaths (16%) were referrred by the ambulance service and 35 deaths (21%) were referred by the police.

In 62 cases (36%) the GP issued a certificate of cause of death without referral to the fiscal. No differences were identified between the cases referred and not referred to the fiscal with respect to age, sex or area of residence of the deceased.

Only three of the deaths seen by the GP occurred outside the home of the deceased. They occurred in the homes of relatives or friends of the deceased. Two cases were referred to the fiscal.

C. Decisions by the General Practitioner

Table C.1 (see Appendix 8) summarises the decision by the GP to refer a case to the fiscal in relation to whether death was witnessed. 43 of the 63 witnessed deaths (68%) were referred compared with 63 of 74 unwitnessed deaths (84%). The difference is not statistically significant.

Table C.2 (see Appendix 8) summarises the decision by the GP to refer a case to the fiscal in relation to symptoms of myocardial infarction preceding death. 50 of 76 cases (66%) with symptoms of myocardial infarction preceding death were referred compared with 58 of 94 (62%) of cases without symptoms of myocardial infarction preceding death. The difference is not statistically significant.

Table C.3 summarises the decision by the GP to refer a case to the fiscal in relation to a previous medical history of coronary heart disease. 43 of the 80 (54%) cases with a previous medical history of coronary heart disease were referred compared with 63 of 85 cases (71%) without a previous medical history of coronary heart disease. The difference is statistically significant ($p < 0{\cdot}05$)

Table C.4 summarises the decision by the GP to refer a case to the fiscal in relation to the presence or absence of symptoms of myocardial infarction preceding death in cases with and without a previous medical

Table C.3 Breakdown of cases seen by GPs by previous medical history of coronary heart disease and whether referred to the fiscal.

	PMH	No PMH	PMH not known	Total
Referred to the Fiscal	43	63	2	108
Not Referred	37	22	3	62
Total	80	85	5	170
% Referred	54	71	40	64

Null hypothesis

There is no association between the decision to refer a case to the fiscal and the presence of a known medical history of coronary heart disease.

$x^2 = 5{\cdot}46$, 1 d.f., $p < 0{\cdot}05$

Conclusion:

The hypothesis is rejected.

Comment:

There is probably an association between the decision to refer a case to the fiscal and the presence of a known history of coronary heart disease.

medical history of coronary heart disease. 13 of 27 cases (52%) with a previous medical history of coronary heart disease and with symptoms of myocardial infarction preceding death and 29 of 41 cases (55%) with a previous medical history of coronary heart disease but without symptoms of myocardial infarction were referred to the fiscal. In cases without a previous medical history of coronary heart disease the referral rate to the fiscal for those cases with and without preceding symptoms of myocardial infarction was 73% (36 of 49) and 70% (29 of 41) respectively. The difference is not statistically significant.

8 of the 62 cases (13%) which had not been referred to the fiscal had received hospital treatment within 3 weeks prior to death; 6 had been hospital in-patients, 1 had attended an A&E department 2 days prior to death and another had been visited by a hospital consultant on the day prior to death. 5 of the 108 cases (5%) referred to the fiscal by the GP had received hospital treatment within 3 weeks prior to death: 4 had been hospital in-patients and another had attended an outpatient clinic 11 days prior to death.

Table C.4 Breakdown of cases seen by GPs with/without a previous medical history of coronary heart disease with/without symptoms of myocardial infarction preceding death and whether referred to the fiscal.

	PMH with Symptoms	No PMH with Symptoms	PMH without Symptoms	No PMH without Symptoms	TOTAL
Referred to the Fiscal	14	36	29	29	108
Not Referred	13	13	24	12	62
Total	27	49	53	41	170
% Referred	52	73	55	70	64

Comment:

The presence or absence of symptoms of myocardial infarction in cases with and without a previous history of coronary heart disease made no difference to the referral rate by GPs to the fiscal.

PMH = Previous Medical History of coronary heart disease

C. Decisions by the General Practitioner

Figures C1 & C2 describe the information, including ECG and enzyme data, available at the time the decision was made by the GP whether to refer the death to the fiscal. 41 of the cases seen by GPs (24%) had no symptomatic, ECG/enzyme or previous medical history to support a diagnosis of coronary heart disease.

12 of these cases (29%) were not referred to the fiscal; 6 deaths had been witnessed (in 1 case cardiac arrest followed a prolonged epileptic seizure and in 5 cases details of symptoms preterminally were not recorded), in 5 cases it was not recorded whether death had been witnessed and therefore details of symptoms preterminally were not known and in the remaining case, death was unwitnessed therefore this information would only be available if it had been recorded in the 28 day period before death.

GPs agreed to certify a further 30 deaths which had been notified to the fiscal ie presumably the GP and fiscal had agreed on the diagnosis. 23 of these cases had been notified to the fiscal by GP/DDS doctors and 7 by hospital doctors. 7 cases certified by the GP following fiscal notification had no symptomatic, clinical data or previous medical history to support the diagnosis of coronary heart disease.

C. Decisions by the General Practitioner

Figure C.1 Clinical data available for cases not referred to the fiscal (62 cases).

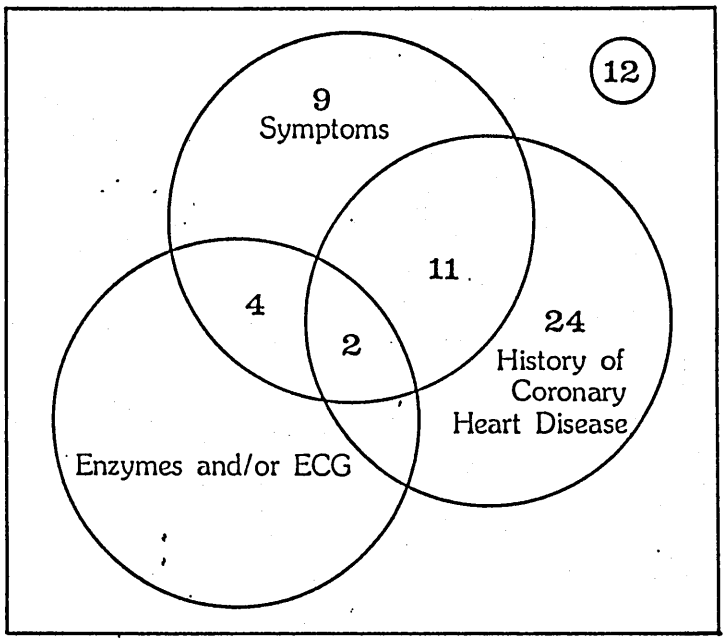
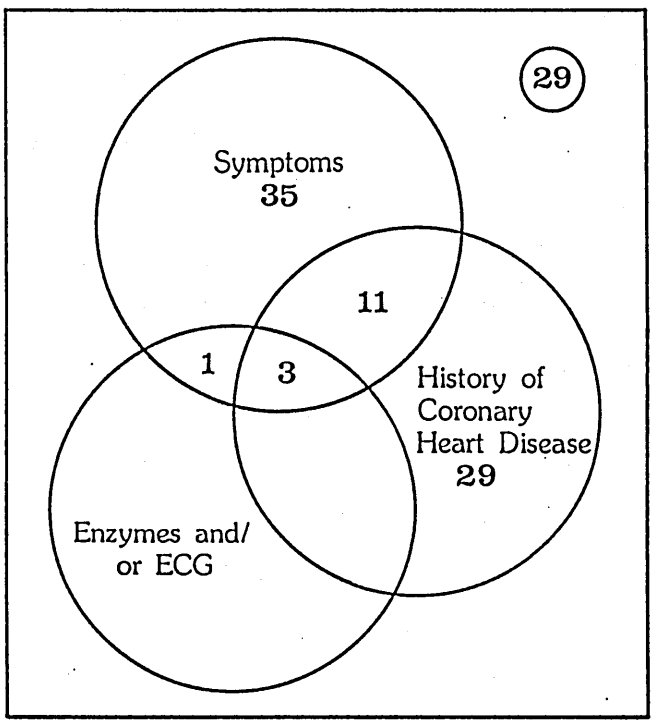


Figure C.2 Clinical data available for cases referred to the fiscal (108 cases).



Summary of Decisions by Ambulance Crews, Police and GPs.

Deaths which occurred outwith the deceased's normal residence and deaths which were sudden ie without preceding symptoms, were more likely to be taken to hospital when ambulancemen were the first persons in attendance.

The referred rate of cases by the police and the fiscal was not influenced by age, sex, symptoms or area of residence of the deceased.

Virtually all deaths (167 / 170) seen by GPs/DDS doctors occurred in the deceased's home.

The referral rate to the fiscal by GPs/DDS doctors was influenced by a previous medical history of coronary heart disease preceding death. Neither the presence of symptoms of myocardial infarction before death nor the absence of witnesses to the death influenced the GP's decision to refer a case to the fiscal.

19 cases (19%) certified by GPs/DDS doctors, 12 without referral to the fiscal and 7 following fiscal referral, had neither a previous medical history nor symptomatic/clinical evidence to suport the diagnosis of coronary heart disease.

D. Possible decisions by the hospital doctor

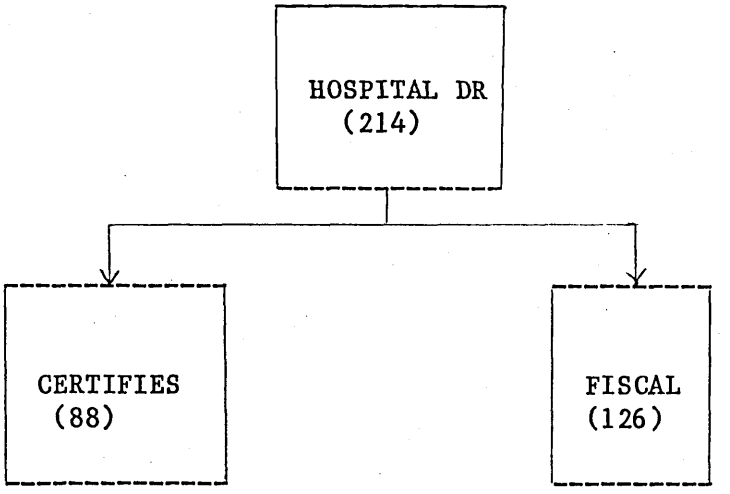
Introduction

The possible options available to the hospital doctor before certifying a death include:-

(1) certifying the cause of death without referral to the fiscal, or

(2) notifying the fiscal for possible investigation.

The diagram below illustrates these possible decisions by the hospital doctor in relation to the study death.



214 (51%) deaths were first medically confirmed as dead by a hospital doctor. In 88 cases (41%) the clinician issued a certificate of cause of death without referral to the fiscal.

Table D.1 summarises the deaths referred to the fiscal by doctors in different hospital departments.

D. Decisions by hospital doctors

Table D.1 Breakdown of cases seen by a hospital doctor by place of death and whether referred to the fiscal.

	Unknown	Staff	A&E	DOA	CCU	General Ward	Other Ward	TOTAL
Referred	0	2	7	87	15	5	10	126
Not referred	1	0	1	3	44	36	3	88
Total	1	2	8	90	59	41	13	214
% Referred	0	100	88	97	25	12	77	59

D. Decisions by hospital doctors

97% of cases which were dead on arrival at hospital and 88% of deaths in A&E departments were referred to the fiscal. 25% of deaths in coronary care units, 12% of deaths in general medical wards and 77% of deaths in hospital departments other than a CCU or a general medical ward were referred to the fiscal.

Place of death unknown

Neither hospital casenotes nor A&E records could not be found for one death certified by a hospital doctor without referral to the fiscal. It was not possible to ascertain the place of death or obtain any information concerning the diagnostic evidence available to the hospital doctor at the time of certificiation.

Hospital Workers

2 hospital staff died at their place of work. Both deaths were referred to the fiscal.

Deaths on Arrival at Hospital

90 cases were medically confirmed to be dead on arrival at hospital; 69 (77%) men and 21 (23%) women. 3 deaths (3%) were certified by the hospital doctor without referral to the fiscal. These deaths occurred in transit to hospital: in 2 cases death was preceded by chest pain. The remaining death occurred in a 48 year old man with a history of myocardial infarction six

months prior to death. He was attended by his GP following sudden collapse. He was resuscitated by the GP following cardiac arrest in the ambulance and admitted directly to a CCU where cardiopulmonary efforts were continued for two hours.

Deaths in Accident and Emergency Departments

8 patients died in hospital A&E departments. The one death which was not referred to the fiscal had symptoms of myocardial infarction preceding death and a previous medical history of coronary heart disease.

Coronary Care Unit Deaths

59 patients, 41 male and 18 female, died in coronary care units (CCU). 44 of the deaths (75%) occurring in CCU were certified by a hospital doctor without referral to the fiscal. There were no age or sex differences between cases which were referred or not referred to the fiscal.

As virtually all of the patients (57 out of 59) had symptoms of myocardial infarction, the presence of symptoms did not influence the decision to refer a death to the fiscal.

Table D.2 shows the referral rate to the fiscal in relation to survival time in hospital. 14 of the 15 patients (93%) referred to the fiscal by the CCU doctor

Table D.2 Breakdown of deaths in CCU by survival from admission and whether referred to the fiscal.

	Died within 24hrs	Died after 24hrs	Total
Referred to fiscal	14	1	15
Not referred	16	28	44
Total	30	29	59
% Referred	47	3	25

Null Hypothesis

There is no association between the decision to refer a case to the fiscal and the survival time from admission to hospital.

$x^2 = 12{\cdot}34$, 1 d.f., $p < 0{\cdot}001$

Conclusion

The hypothesis is rejected.

Comment

There is probably an association between the decision to refer a case to the fiscal and the survival time from admission to hospital.

died within 24 hours of admission including one patient who had been discharged from hospital, where he had been managed for an acute coronary event, on the day preceding death. In contrast only 16 of 44 patients (36%) not referred to the fiscal died within 24 hours of hospital admission. The difference is statistically significant ($p < 0{\cdot}001$).

Table D.3 (see appendix 8) shows the relationship of a previous medical history of coronary heart disease to the referral rate of deaths to the fiscal. 11 of 37 cases (30%) with a previous medical history of coronary heart disease were referred to the fiscal compared to 3 of 18 cases (17%) with no previous medical history of coronary heart disease. Details concerning the medical history could not be obtained for 4 cases. The difference is not statistically significant ($p > 0{\cdot}10$).

Table D.4 shows the availability of clinical data ie ECG and/or enzymes information according to whether the case was referred to the fiscal. ECGs had been recorded for 7 patients (47%) referred to the fiscal and for 38 patients (86%) not referred to the fiscal. Serial cardiac enzyme estimations had been performed for 4 patients (27%) referred to the fiscal and for 30 patients (68%) not referred to the fiscal. The difference is statistically significant ($p < 0{\cdot}01$).

Table D.4 Breakdown of cases seen by CCU doctors by availability of clinical data and whether referred to the fiscal.

	Clinical data	No clinical data	Total
Referred to fiscal	7	8	15
Not referred	38	6	44
Total	45	14	59
% Referred	16	57	25

Null Hypothesis

There is no association between the decision to refer a case to the fiscal and the presence of clinical data supporting the diagnosis of coronary heart disease.

$x^2 = 7{\cdot}67$, 1 d.f., $p < 0{\cdot}01$

Conclusion

The hypothesis is rejected.

Comment

There is probably an association between the decision to refer a case to the fiscal and the presence of clinical data supporting the diagnosis of coronary heart disease.

D. Decisions by hospital doctors

Figures D.1 and D.2 summarise the diagnostic information available to the coronary care doctor at the time the decision was made to certify the death with or without referral to the fiscal. Only one patient had no symptoms and no ECG or cardiac enzyme information and this case was referred to the fiscal.

Figure D.1 Clinical data available for cases referred to the fiscal (15 cases).

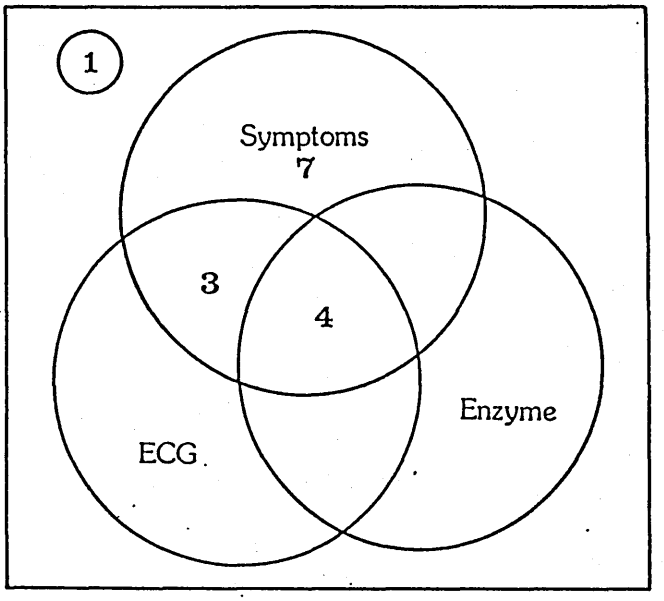
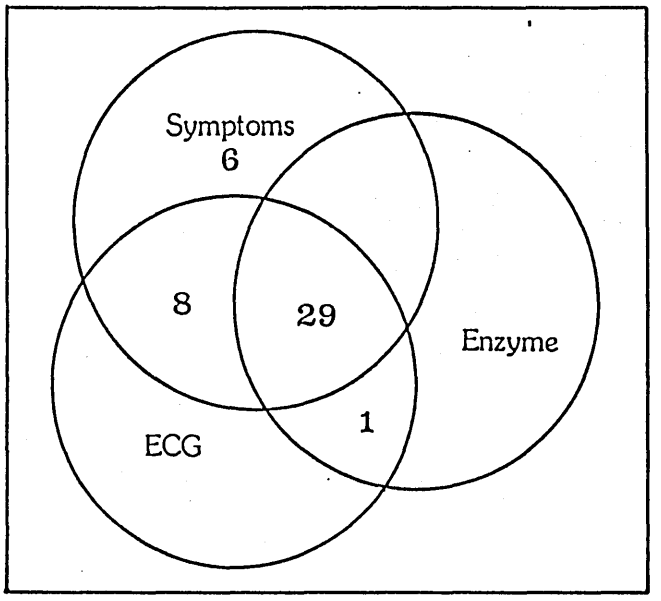


Figure D.2 Clinical data available for cases not referred to the fiscal (44 cases)



D. Decisions by hospital doctors

General medical ward deaths

41 patients died in general medical wards; 27 males (66%) and 14 females (34%). Only 5 deaths (12%) were referred to the fiscal; 4 deaths had no previous medical history of coronary heart disease and 1 had a myocardial infarction three years earlier.

There were no age or sex differences between cases referred to the fiscal and cases certified by the hospital physcian without referral to the fiscal.

Only 2 of the 41 patients who died in general medical wards had no symptomatic or clinical evidence of myocardial infarction. One of these cases was referred to the fiscal.

Table D.5 (see appendix 8) shows the referral rate to the fiscal in relation to survival time in hospital. 4 of the 9 patients (31%) who died within 24 hours of hospital admission compared with 1* of 28 patients (4%) who died after 24 hours of admission to hospital were referred to the fiscal.

(*Examination of the records of this case revealed that the patient had a history of pulmonary asbestosis.)

Deaths which occurred in "other" hospital departments

10 (77%) of the 13 deaths which occurred in hospital departments other than an A&E, CCU or a general medical ward were referred to the fiscal; 2 deaths occurred during investigative procedures for coronary heart disease; 6 deaths occurred either during or following cardiac surgery and in 4 cases the surgical procedure was an emergency e.g. one patient suffered myocardial infarction with rupture of the papillary muscle following an emergency mitral valve replacement operation. The death of a patient who was suspected to have accidently overdosed on paracetamol, which had been self-prescribed to treat her coronary symptoms, was reported to the fiscal and the remaining death occurred in man who died suddenly during treatment for gastric symptoms.

3 deaths (23%) were not referred to the fiscal; 2 patients had symptoms and ECG evidence of myocardial infarction including one who survived only 15 minutes from admission to hospital. The remaining case had no diagnostic information ie no symptoms, ECG or enzyme data for myocardial infarction, and was being treated for acute pulmonary oedema following blood transfusion. A hospital post-mortem revealed the cause of death as pulmonary oedema.

Summary of Decisions By Hospital Doctors to Refer A Case to the Fiscal

90% of patients referred to the fiscal by CCU and general ward physcians died within 24 hours of admission to hospital. 25% (15 of 59) of deaths of CCU patients and 12% (5 of 41) of deaths in medical ward patients were referred to the fiscal. The difference in the referral rates by doctors in these wards probably reflects the lower proportion of deaths within 24 hours of admission in general medical wards ie 32% (13 of 41 patients) compared with 51% (30 of 59) of deaths within 24 hours of admission in CCU.

The absence of a previous medical history did not appear to determine which cases were referred to the fiscal by CCU doctors; only 5% of cases referred to the fiscal had no previous medical history of coronary heart disease. Approximately one half of the patients without ECG or enzyme data for myocardial infarction were referred to the fiscal.

Virtually all coronary deaths which occur in hospital departments other than a general medical ward or coronary care unit were referred to the fiscal.

E. Postmortems requested by hospital doctors

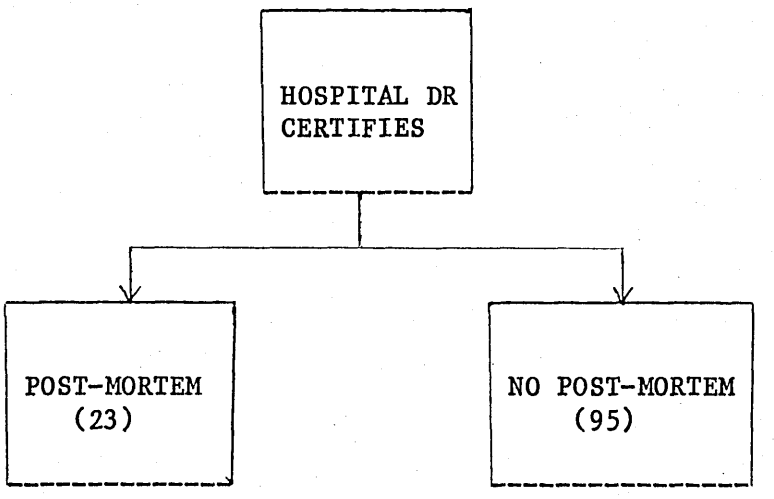
Introduction

Before certifying a death the hospital doctor has the options of:-

(1) requesting a post-mortem examination, or

(2) certifying the death without post-mortem examination.

The diagram below illustrates these possible decisions by hospital doctors in relation to the study deaths.



Hospital doctors certified death in 118 cases (28%) in the study population, including 30 cases which had been notified to the fiscal. Post-mortem examination was carried out on behalf of the clinician on 23 patients (19%).

8 cases which proceeded to hospital post-mortem had been referred back to the hospital clinican for certification by the fiscal. Only 1 of these cases had been subject to police investigation and this death occurred in a 55

year old man whose death was preceded by gastrointestinal symptoms. The post-mortem examination on this case was the only one performed on the request of both the clinician and fiscal.

Of the remaining 7 cases referred back to the hospital clinican by the fiscal and which proceeded to post-mortem investigation, 4 died within 24 hours of onset of symptoms. The other 3 cases include the death of a 39 year old man whose death followed his third myocardial in a six months, a 46 year old woman who died suddenly but who had a history of two previous myocardial infarctions and a 63 year old woman who died 10 days following a mitral valve replacement operation.

Table E.1 summarises the deaths certified by hospital doctors with and without post-mortem investigation in relation to the place of death. 4 of the 5 patients (80%) who died in "other" hospital departments had post-mortem examination on behalf of the clinician whilst only 7 of the 58 patients (12%) who died in CCUs proceeded to post-mortem examination on behalf of the hospital clinician.

Table E.1 Breakdown of deaths certified by hospital doctors by place of death and whether post-mortem investigation was performed.

	CCU	Medical	Other	A&E	DOA	Unknown	Total
Post-mortem	7	8	4	1	3	0	23
No Post-mortem	51	31	1	6	5	1	95
Total	58	39	5	7	8	1	118
% Post-mortem	12	21	80	14	35	0	19

Table E.2 (see appendix 8) shows the hospital post-mortem rate in relation to the presence of symptoms of myocardial infarction preceding death. 18 of 100 deaths (18%) with symptoms of myocardial infarction and 5 of 18 (28%) deaths without symptoms of myocardial infarction had post-mortem investigation. The difference is not statistically significant ($p > 0{\cdot}50$).

Table E.3 shows the post-mortem rate in relation to a previous medical history of coronary heart disease. Post-mortem was carried out on behalf of the clinician on 10 of 69 patients (13%) with a previous medical history of coronary heart disease and 13 of 39 patients (33%) with no significant previous medical history. The difference is statistically significant ($p < 0{\cdot}05$).

Table E.4 (see appendix 8) shows the hospital post-mortem rate in relation to the availability of clinical data ie ECG and enzyme data. Post-mortem was carried out on 15 of 78 patients (19%) with clinical data for myocardial infarction and in 8 of 40 patients (20%) without clinical data supporting myocardial infarction. The difference is not statistically significant ($p > 0{\cdot}50$).

E. Decisions by hospital doctors

Table E.3 Breakdown of deaths certified by hospital doctors by previous medical history of coronary heart disease and whether post-mortem was performed.

	PMH	no PMH	Total
Post-mortem	10	13	23
No Post-mortem	69	26	95
Total	79	39	118
% Post-mortem	13	33	19

Null Hypothesis

There is no association between the decision to perform a hospital post-mortem and presence of a previous medical history of coronary heart disease.

$x^2 = 5{\cdot}86$, 1 d.f., $p < 0{\cdot}05$

Conclusion

The hypothesis is rejected.

Comment

There is probably an association between the decision to perform a hospital post-mortem and the absence of a previous medical history of coronary heart disease.

E. Decisions by hospital doctors

Table E.5 shows the post-mortem rate in relation to cases with/without a previous medical history of coronary heart disease and with/without symptoms of myocardial infarction preceding death. 6 of the 64 deaths (9%) preceded by symptoms of myocardial infarction in patients with a previous medical history of coronary heart disease proceeded to hospital post-mortem. 12 of 36 deaths (33%) without preceding symptoms of myocardial infarction and without a previous medical history of coronary heart disease had a hospital post-mortem performed.

Figures E.1 and E.2 illustrate the diagnostic information available to the clinician before the decision was made to proceed to post-mortem. Two cases had neither symptoms nor ECG or enzyme data for myocardial infarction. Only one case proceeded to post-mortem examination.

Table E.5 Breakdown of cases certified by hospital doctors with/without a previous medical history of coronary heart disease and with/without symptoms of myocardial infarction preceding death and whether a post-mortem was performed.

	Symptoms with PMH	Symptoms no PMH	No Symptoms with PMH	No Symptoms no PMH	Total
Post-mortem	6	12	4	1	23
No Post-mortem	58	24	11	2	95
Total	64	36	15	3	118
% Post-mortem	9	33	27	33	19

Comment

The presence or absence of symptoms of myocardial infarction prior to death appears to make no difference to the hospital post-mortem rate if there is no previous medical history of coronary heart disease. However, if there is a previous medical history of coronary heart disease the presence of symptoms of myocardial infarction does appear to influence the rate of post-mortems.

E. Decisions by hospital doctors

Figure E.1 Clinical data available to hospital doctors for cases certified following post-mortem (23 cases).

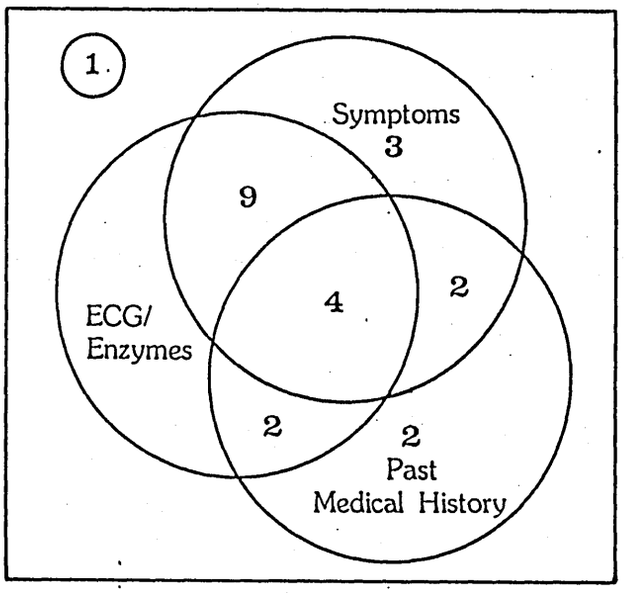
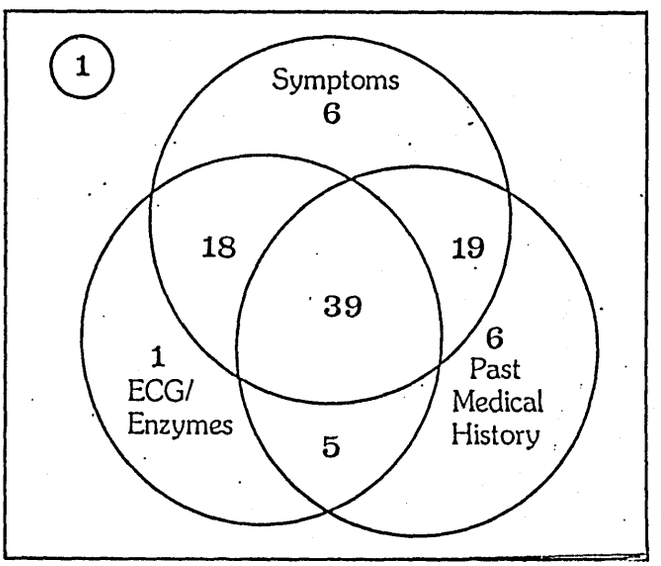


Figure E.2 Clinical data available to hospital doctors for cases certified without post-mortem (95 cases).



NB 2 cases had no symptoms, typical or atypical of myocardial infarction, and no ECG or enzyme data. Only one case proceeded to post-mortem examination.

Summary of Decisions by Hospital Doctors to Perform Post-mortem Investigation

19% of deaths certified by hospital doctors proceeded to post-mortem examination; approximately one third had been reported to the fiscal, but the fiscal had not requested post-mortem examination.

The majority of coronary deaths (80%) which occurred in a ward other than a general medical ward or coronary care unit had a post-mortem.

Hospital deaths were less likely to proceed to post-mortem if there was a previous medical history and symptoms of coronary heart disease preceding death.

The presence or absence of clinical data supporting the diagnosis of myocardial infarction did not affect the decision to carry out post-mortem examination (19% of patients with clinical data for myocardial infarction and 20% of patients without clinical data for myocardial infarction had post-mortem examination on behalf of the hospital clinician).

Deaths notified to the Procurator Fiscal

A total of 269 deaths (64%) in the study population were referred to the fiscal; 190 male (71%) and 79 female (29%). 126 deaths were referred by hospital doctors, 32 by the police and 111 by GPs (GPs/DDS doctors). Table F.1 summarises the cases which were referred to the fiscal by the various medical and legal agencies.

F. Possible decisions by the procurator fiscal.

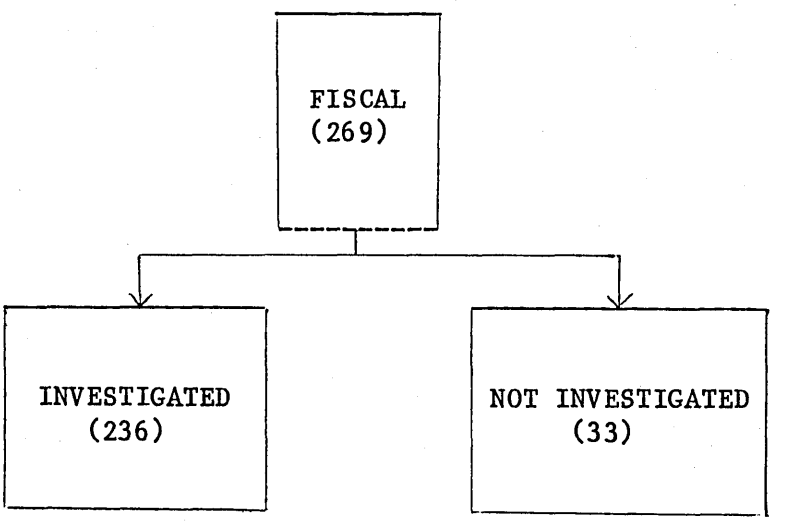
Introduction

When notified of a case the fiscal has the possible options to:-

(1) instigate a police investigation concerning the circumstances of the death and the previous medical history, or

(2) to refer the case to a doctor for certification without investigation.

The diagram below illustrates these possible decisions in relation to the study deaths.



F. Decisions by the procurator fiscal.

Table F.1 Breakdown of cases notified to the fiscal by the different medical and legal agencies.

	Number of deaths referred to fiscal	% of all cases referred
Hospital Doctors	126	47
Police	32	12
GPs	111	41
Total	269	100

F. Decisions by the procurator fiscal.

236 cases were investigated by the police and 33 cases were referred back by the fiscal to a doctor for certification without further investigation.

Table F.2 describes the cases investigated by the fiscal in relation to the place of death. 4 deaths (20%) in CCUs and general medical wards were subject to police investigation on behalf of the fiscal whereas 3 deaths (43%) in A&E and 11 deaths (92%) in "other" hospital departments were investigated. Police investigation was carried out for 82 deaths on arrival at hospital (94%) and for a further 135 deaths (94%) in the community.

DEATHS IN THE COMMUNITY

31 of the 32 cases referred to the fiscal by the police were subject to investigation. The remaining case was referred to the GP for certification.

GPs/DDS doctors referred 111 cases to the fiscal, 104 cases (72 of the male deaths and 32 of the female) proceeded to investigation.

DEATHS ON ARRIVAL AT HOSPITAL

87 deaths which were confirmed dead on arrival at hospital were referred to the fiscal by hospital doctors. 82 deaths (94%) proceeded to fiscal investigation.

F. Decisions by the procurator fiscal.

Table F.2 Breakdown of deaths notified to the procurator fiscal by place of death and whether investigated by the procurator fiscal.

	CCU and Medical Ward	Other Hospital Department and Workers	D.O.A.	A&E	Community Referred by		TOTAL
					Police	GP	
Fiscal order investigation	4	11	82	4	31	104	236
No Fiscal investigation ordered	16	1	5	3	1	7	33
TOTAL	20	12	87	7	32	111	269
% investigated	20%	92%	94%	43%	97%	94%	88%

Decisions by the procurator fiscal.

4 deaths were referred back to the hospital doctor for death certification without further investigation. Each case had a previous medical history of myocardial infarction and/or angina. One death was preceded by typical symptoms of myocardial infarction, one patient collapsed without symptoms and two deaths were unwitnessed.

1 case was referred to the GP for certification. This man who collapsed without symptoms had a history of myocardial infarction and angina.

HOSPITAL DEATHS

3 of the 7 deaths (43%) in A&E departments reported to the fiscal were referred back to the clinician without fiscal investigation. These deaths were preceded by symptoms of myocardial infarction and 2 had a previous medical history of coronary heart disease which includes the death of a 42 year old man who had been a hospital in-patient nine days prior to death.

20 deaths were referred to the fiscal by physicians in CCUs and general medical wards. In 4 cases (20%) the fiscal ordered a police investigation. The other 16 cases (80%) were referred back to the physician for certification of cause of death. 3 deaths (75%) investigated were preceded by symptoms not associated with coronary heart disease. All 16 deaths not investigated were preceded by symptoms of coronary heart disease.

F. Decisions by the procurator fiscal.

4 deaths (100%) investigated and 6 deaths (38%) not investigated had no ECG or enzyme evidence of myocardial infarction.

9 of the 10 deaths (90%) which occurred in hospital departments other than general medical wards or CCUs and which were referred to the fiscal, were subject to fiscal investigation. In 2 cases, the clinician was uncertain of the cause of death; one death was preceded by haematemesis and in another there was clinical evidence of accidental drug overdose. The deaths of 7 patients who died during or within 48 hours of investigative or surgical procedure were investigated by the fiscal. The death of a woman who died ten days after a mitral valve replacement operation was not subject to fiscal investigation.

The deaths of the 2 hospital workers proceeded to police investigation on behalf of the fiscal.

Summary of Decision by Procurator Fiscal to Investigate A Case

The fiscal investigated the majority of deaths which occurred in the community. Hospital deaths, with the exception of deaths in "other" hospital departments were not investigated by the fiscal.

Deaths Investigated by the Procurator Fiscal

237 deaths were subject to police investigation on behalf of the fiscal; 101 cases were referred by hospital doctors, 104 by GPs/DDS doctors and 31 by police authorities. The death of a woman who died abroad and whose death certificate diagnosis was inadequate for cremation purposes, was also investigated by the fiscal.

G. Decisions by the Procurator Fiscal Following Police Investigation.

Introduction

Once the fiscal has investigated a case he has the possible options to refer the case to:

(1) the doctor who notified him of the case for certification ie the GP or hospital doctor,

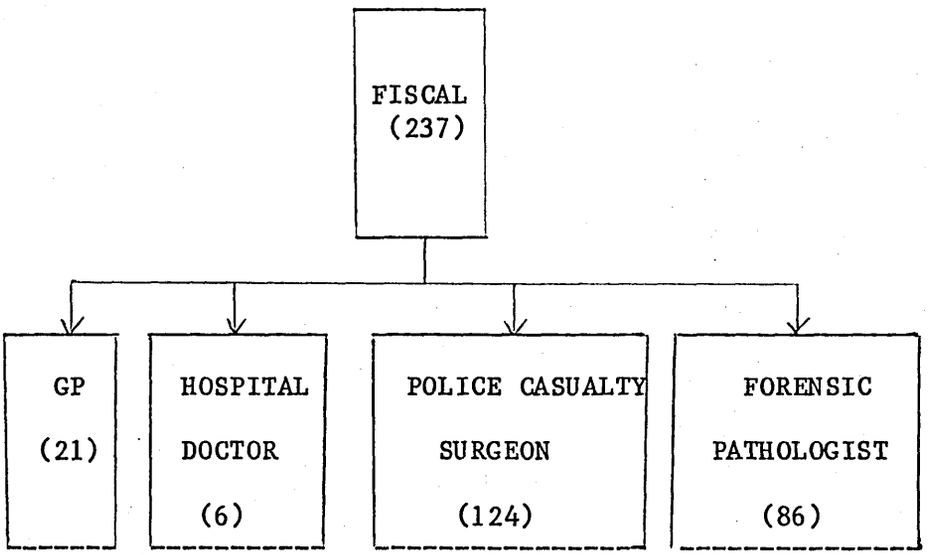
(2) the deceased's GP,

(3) a PCS, or

(4) a forensic pathologist for possible post-mortem investigation.

The diagram below illustrates the possible decisions taken by the fiscal following police investigation in relation to the study deaths.

G. Decisions by the procurator fiscal



The GP certified the cause of death for 21 cases following police investigation; 6 were cases of death on arrival at hospital and 15 died in the community.

6 cases were referred back to hospital doctors for certification following fiscal investigation; 1 death occurred in a CCU, 3 in A&E departments, 1 in an "other" hospital department and 1 was DOA at hospital.

Of the remaining 210 deaths, the fiscal referred 124 to a PCS and 86 to a forensic pathologist. Of the 86 cases referred directly to a forensic pathologist, 2 were deaths of hospital workers at their place of work, 72 were dead on arrival at hospital, 8 died during or shortly after an investigative or surgical procedure, 1 had died in a CCU, 1 in a general ward, 1 in an A&E department and 1 was the death of a woman who died abroad.

G. Decisions by the procurator fiscal

Virtually all deaths on arrival (72 of 75) were referred to the forensic pathologist and all community deaths (120) to PCSs. Table G summaries the referral rate to the PCS and to the forensic pathologist in relation to the place of death.

G. Decisions by the procurator fiscal

Table G Breakdown of cases investigated by the fiscal by place of death and whether referred to a PCS or a forensic pathologist.

	COMMUNITY DEATH	DOA	HOSPITAL DEATH	OTHER	TOTAL
Referred to PCS	120	3	1	0	124
Referred to F.PATH	0	72	13	1	86
Total	120	75	14	1	210
% Referred to F.PATH	0	96	93	100	41

H. Possible decisions by the Police Casualty Surgeon

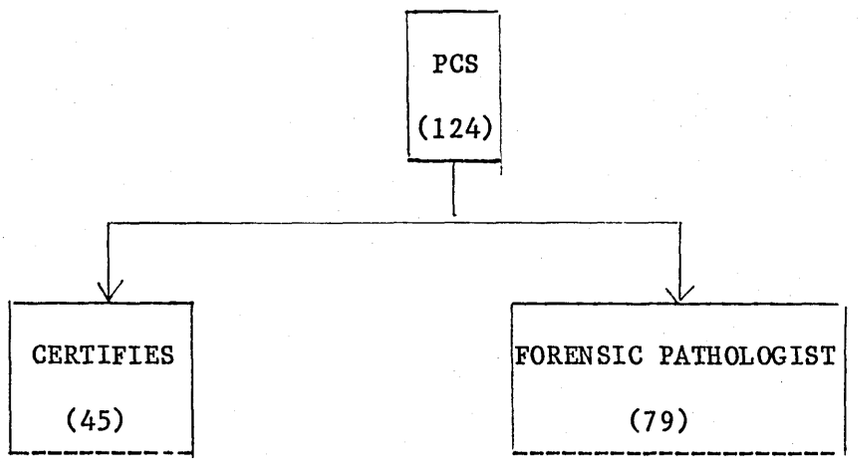
Introduction

When notified of a case the PCS has the possible options to:-

(1) issue a death certificate, or

(2) refer the case to a forensic pathologist.

The diagram below illustrates the possible decisions taken by the PCS in relation to the study deaths.



The PCS issued a certificate of cause of death for 45 cases (36%) and referred 79 (64%) to the forensic pathologist.

Table H.1 summaries the cases referred to the forensic pathologist for certification by the PCS in relation to place of death. 43 deaths occurred in the community, 1 was dead on arrival at hospital and 1 died in a general medical ward.

H. Decisions by the police casualty surgeon

Table H.1 Breakdown of cases seen by the PCS by place of death and whether referred to the fiscal.

	Community	DOA	Hospital	Total
Certified by PCS	43	1	1	45
Referred to For.Path	77	2	0	79
Total	120	3	1	124
% Referred to For.Path	64	67	0	64

H. Decisions by the police casualty surgeon

PCSs certified 26 male deaths (31%) and 17 female (46%) which occurred in the community and were referred to them by the fiscal. There was no difference in area of residence between cases referred by the PCS to the forensic pathologist and those certified by the PCS.

Table H.2 (see appendix 8) shows the referral rate to the forensic pathologist in relation to whether death was witnessed. 24 of 45 witnessed deaths (53%) were referred to the forensic pathologist compared to 55 of the 77 (71%) of unwitnessed deaths. The difference is not statistically significant ($p > 0{\cdot}05$).

Table H.3 (see appendix 8) shows the referral rate in relation to symptoms of myocardial infarction preceding death. 27 of 48 cases (56%) with symptoms of myocardial infarction preceding death were referred to the forensic pathologist compared to 52 of 74 cases (70%) without symptoms. The difference is not statistically significant($p > 0{\cdot}10$).

Table H.4 shows the referral rate in relation to a previous medical history of coronary heart disease. 16 of 39 cases (41%) referred to the forensic pathologist had a previous medical history of coronary heart disease compared to 63 of 83 cases (76%) without a previous medical history of coronary heart disease. The difference is statistically significant ($p < 0{\cdot}001$).

Table H.4 Breakdown of cases seen by the PCS by previous medical history of coronary heart disease and whether referred to the forensic pathologist.

	PMH	No PMH	Total
Refer to For. Path	16	63	79
Not referred	23	20	43
Total	39	83	112
% Referred	41	76	65

Null Hypothesis

There is no association between the decision to refer a case to the forensic pathologist and a previous medical history of coronary heart disease.

$x^2 = 15{\cdot}24$, 1 d.f., $p < 0{\cdot}001$

Conclusion

The hypothesis is rejected.

Comment

There is probably an association between the decision to refer a case to the forensic pathologist and the absence of a previous medical history of coronary heart disease.

H. Decisions by the police casualty surgeon

Table H.5 shows the referral rate to the forensic pathologist in relation to cases with/without a previous medical history of coronary heart disease and with/without symptoms of myocardial infarction preceding death. 4 of 10 cases (40%) with a previous medical history and symptoms of coronary heart disease and 12 of 29 cases (41%) with a previous medical history but without symptoms were referred to the forensic pathologist. 23 of 38 cases (61%) without a previous medical history of coronary heart disease but with symptoms of myocardial infaction and 40 of 45 cases (89%) with neither symptoms nor a previous history of coronary heart disease were referred to the forensic pathologist.

The characteristics of the 5 cases with neither symptoms nor a previous medical history of coronary heart disease prior to death and which were certifed by the police casualty surgeon were examined. 3 deaths were witnessed and unheralded by any symptoms; 1 case had a medical history of chronic obstructive airways disease, 1 a history of peripheral vascular disease and the other had no significant medical history. 2 of these deaths had been confirmed by a DDS doctor who declined to issue the certificate of cause of death. The other was confirmed dead on arrival at hospital then conveyed to the City Mortuary where the police casualty surgeon certified the death.

H. Decisions by the police casualty surgeon

Table H.5 Breakdown of cases seen by the PCS with/without a previous medical history of coronary heart disease with/without symptoms of myocardial infarction preceding death and whether referred to the forensic pathologist.

	PMH with Symptoms	no PMH, with Symptoms	PMH no Symptoms	no PMH, no Symptoms	TOTAL
Refer to For. Path	4	23	12	40	79
Not referred	6	15	17	5	43
Total	10	38	29	45	122
% Referred	40	61	41	89	65

Comment

For cases with a previous medical history of coronary heart disease the absence of symptoms of myocardial infarction preceding death did not alter the referral rate to the forensic pathologist. However, the absence of symptoms of myocardial infarction for cases without a previous medical history of coronary heart disease did appear to affect the referral rate to the forensic pathologist.

The remaining 2 deaths were unwitnessed; 1 had a previous medical history of chronic obstructive airways disease and the other a medical history of hypertension and diabetes mellitus. Both deaths had been confirmed by a GP/DDS doctor who declined to issue the certificate of cause of death.

Figures H.1 & H.2 illustrate the diagnostic information, including ECG/enzyme information, available for community deaths referred to the PCS at the time of decision to certify death or refer the case to the forensic pathologist. 1 death referred by the police casualty surgeon to the forensic pathologist occurred 2 days following discharge from hospital and ECG and enzyme information was available. 3 deaths certified by the police casualty surgeon without referral to the forensic pathologist occurred within 15 days from discharge from hospital and ECG/enzyme information was available for 2 of these deaths. ECG data was available for a further 2 cases certified by the police casualty surgeon from hospital A&E and Out-patient records.

H. Decisions by the police casualty surgeon

Figure H.1 Clinical data available for cases which were certified by police casualty surgeons (43 cases).

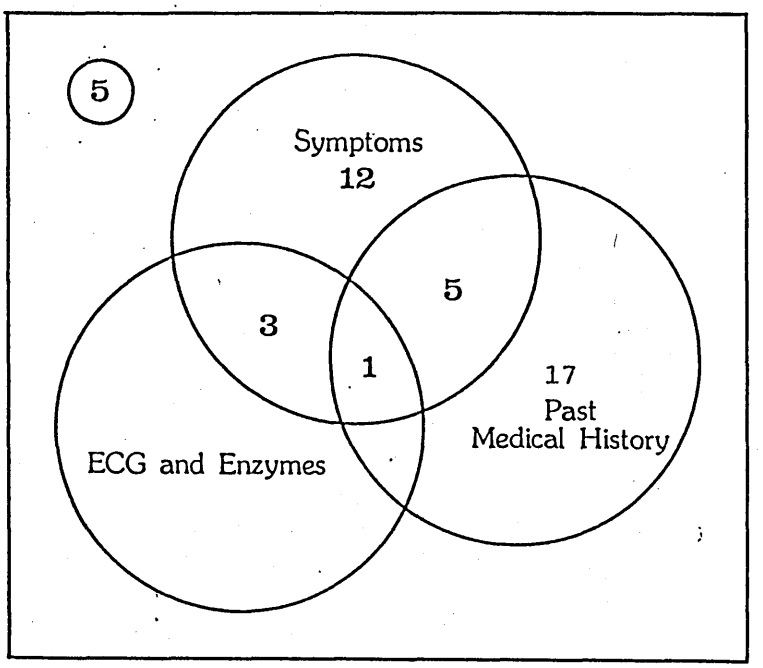
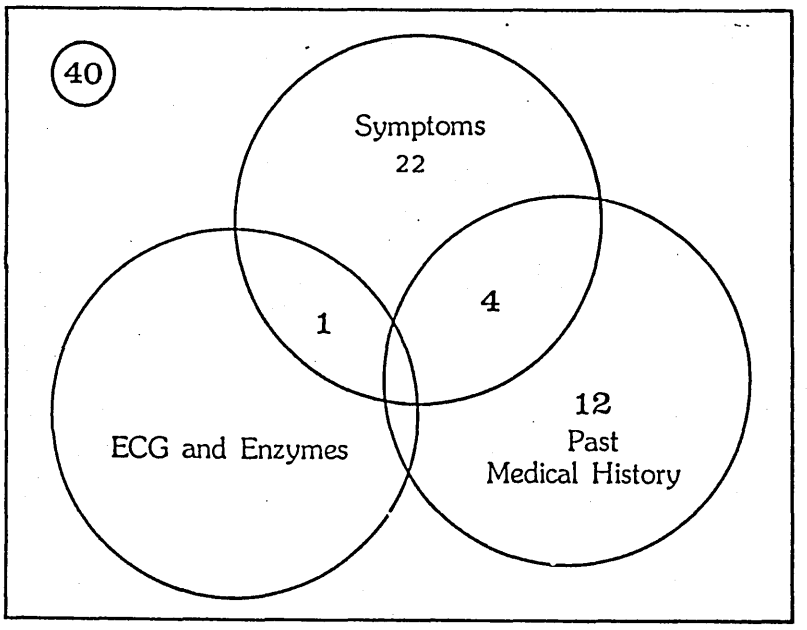


Figure H.2 Clinical data available for cases which were referred by the police casualty surgeons to the forensic pathologists for certification (79 cases).



Cases seen by the Forensic Pathologist

165 deaths (39%) in the study population came to the attention of a forensic pathologist. 13 cases (8%) had died in hospital, 151 cases (92%) died in the community (includes 74 deaths on arrival at hospital and 77 referrals from the PCSs) and 1 death occurred abroad.

I. Possible Decisions by forensic pathologists

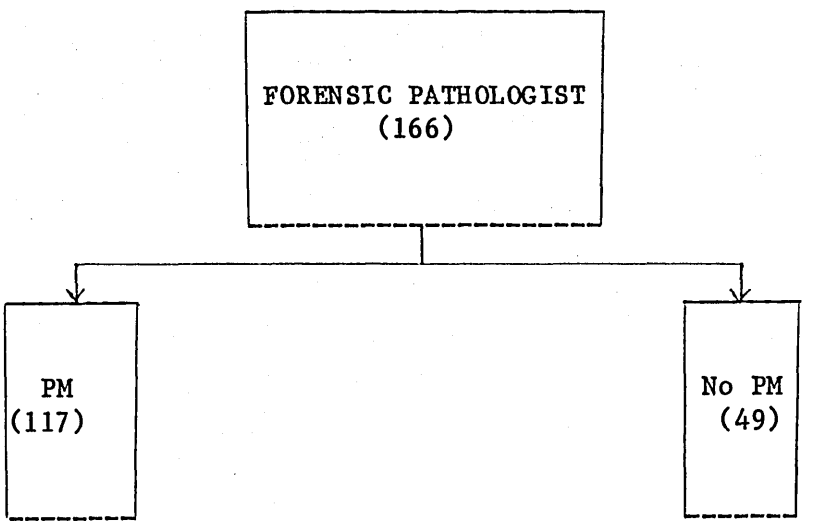
Introduction

When a case is referred to the forensic pathologist he has the possible options of certifying death:-

(1) following external examination only, or

(2) following post-mortem investigation.

The diagram below illustrates the possible decisions made by the forensic pathologist in relation to the study death.



117 deaths (71%) which came to the attention of a forensic pathologist were certified following post-mortem investigation. In 116 cases the forensic pathologist issued the death certificate. In the remaining case the post-mortem findings confirmed the diagnosis on a death certificate issued previously by the GP and the certificate was not amended.

Table I.1 summarises the forensic post-mortem rate in relation to the place of death. All 13 hospital deaths (100%) and 102 community deaths (68%) proceded to post-mortem examination by the forensic pathologist. The death of the woman who died abroad and whose death certificate diagnosis was inadequate for the purposes of cremation in Glasgow was certified by the forensic pathologist following post-mortem examination. 39 of the male deaths (34%) and 10 of the female deaths (28%) which occurred in the community and had been referred to the forensic pathologist did not proceed to post-mortem.

COMMUNITY DEATHS

Table I.2 (see Appendix 8) summarises the cases of death in the community which had a fiscal post-mortem in relation to whether the death was witnessed. 42 community deaths (64%) which were witnessed and 60 community deaths (70%) which were unwitnessed proceded to post-mortem before certification by the forensic

Table I.1 Breakdown of cases certified by the forensic pathologist by place of death and whether a post-mortem investigation was performed.

	HOSPITAL	COMMUNITY	ABROAD	TOTAL
Post-mortem	13	102	1	116
No Post-mortem	0	49	0	49
Total	13	151	1	165
% Post-mortem	100	68	100	70

pathologist. The difference is not statistically significant ($p > 0{\cdot}50$).

Table I.3 (see appendix 8) summarises these cases in relation to the presence of symptoms of myocardial infarction prior to death. 36 of 50 cases (72%) with symptoms had post-mortem investigation compared to 66 of 101 (66%) without symptoms. The difference is not statistically significant ($p > 0{\cdot}50$).

Table I.4 summarises the post-mortem rate in relation to a previous medical history of coronary heart disease. Only 8 of 31 cases (21%) with a previous medical history had post-mortem investigation compared to 94 of 112 cases (84%) without a previous medical history of coronary heart disease. The difference is statistically significant ($p < 0{\cdot}001$).

Table I.5 summarises the post-mortem rate in relation to the presence or absence of symptoms of myocardial infarction preceding death for cases with and without a previous medical history of coronary heart disease. 3 of 9 cases (33%) with a previous medical history of coronary heart disease and with symptoms of myocardial infarction prior to death proceded to post-mortem. However only 5 cases (17%) with a previous medical history of coronary heart disease and without symptoms of myocardial infarction prior to death proceded to

Table I.4 Breakdown of cases certified by the forensic pathologist by previous medical history of coronary heart disease and whether post-mortem investigation was performed.

	PMH	No PMH	Total
Post-mortem	8	94	102
No Post-mortem	31	18	49
Total	39	112	151
% Post-mortem	21	84	68

Null hypothesis

There is no association between the decision to perform a post-mortem and a previous medical history of coronary heart disease.

$x^2 = 50{\cdot}2$, 1 d.f., $p < 0{\cdot}001$

Conclusion

The hypothesis is rejected.

Comment

There is probably an association between the decision to perform post-mortem and the absence of a previous medical history of coronary heart disease.

Table I.5 Breakdown of cases certified by the forensic pathologist with/without a previous medical history of coronary heart disease with /without symptoms of myocardial infarction and whether post-mortem was performed.

	PMH and Symptoms	No PMH with Symptoms	PMH and No Symptoms	No PMH No Symptoms	Total
Post-mortem	3	33	5	61	102
No Post-mortem	6	8	25	10	49
Total	9	41	30	71	151
% Post-mortem	33	80	17	86	68

Comment

The absence of symptoms of myocardial infarction preceding death for cases with and without a previous medical history of coronary heart disease had little influence in determining which cases had a post-mortem examination by the forensic pathologist.

post-mortem. The post-mortem rate by the forensic pathologist for cases with no previous medical history of coronary heart disease with and without symptoms of myocardial infarction prior to death was 80% (33 of 41) and 86% (61 of 71) respectively.

Figures I.1 and I.2 illustrate the diagnostic information, including ECGs and enzymes, available for cases at the time of decision by the forensic pathologist whether to certify death with or without post-mortem evidence.

80 of the community deaths referred to the pathologist had a previous medical history of coronary heart disease and/or symptoms of myocardial infarction preceding death, ie in the absence of a competing cause of death there was sufficient diagnostic information to satisfy the MONICA criteria for a coronary heart disease death. 41 of these cases (50%) had post-mortem investigation

71 of the community deaths (46%) had no symptoms, clinical evidence or previous medical history of coronary heart disease. Of these cases, 10 (7%) were certified by the forensic pathologist without a post-mortem investigation being carried out.

The characteristics of the 10 cases with neither symptoms nor a medical history of coronary heart disease prior to death were examined. Post-mortem investigation

Figure I.1 Clinical data available for cases certified by the forensic patholofist following post-mortem investigation (102 cases).

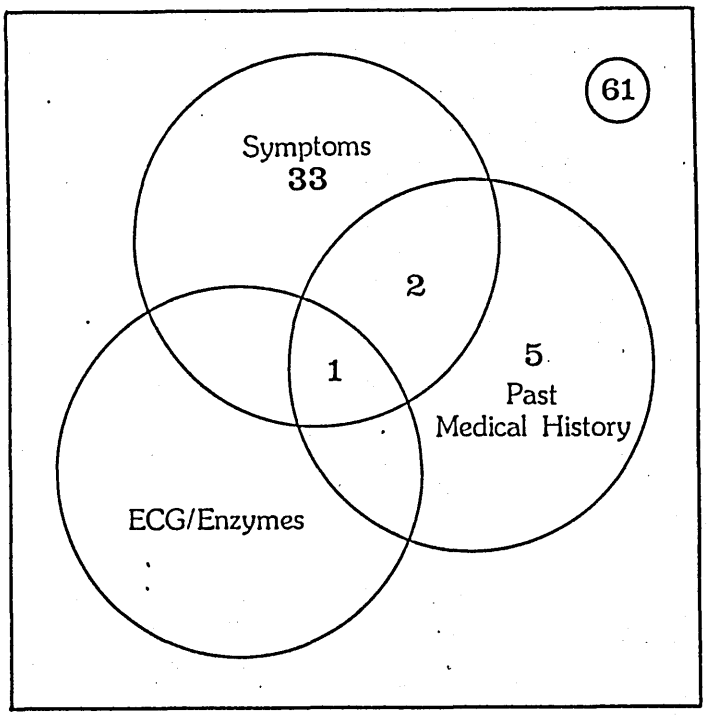
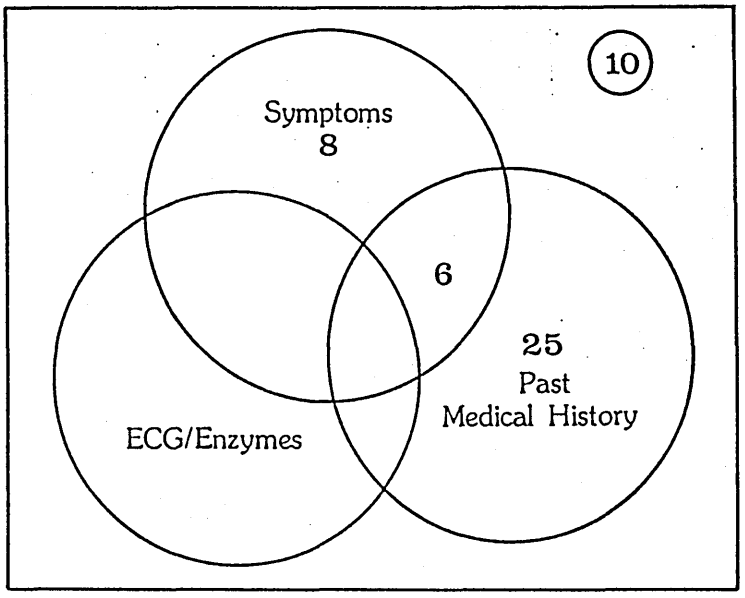


Figure I.2 Clinical data available for cases certified by the forensic pathologist without post-mortem investigation (49 cases).



was not performed in one case because the deceased had a medical history of hepatitis. In 3 cases death had been witnessed and unheralded by any symptoms; 1 had a medical history of gastric ulceration due to alcohol abuse, 1 had a history of alcoholic cardiac failure and the other had no significant medical history. 2 of these cases were confirmed dead on arrival at hospital then conveyed to the City Mortuary and certified by the pathologist without coming to the attention of a police casualty surgeon. The other case died outdoors where death was confirmed by a police casualty surgeon who declined to issue a certificate of cause of death.

The remaining 6 deaths were unwitnessed; 2 had a medical history of hypertension, 1 had diabetes mellitus, 1 had a medical history of chronic obstructive airways disease, 1 was being treated for pernicious anaemia and the other had no significant medical history. 4 cases had died at home where the police casualty surgeon declined to issue the certificate of cause of death. In the remaining two cases death had been confirmed on arrival at hospital; 1 case which had facial abrasions died outdoors and was taken to the City Mortuary where the police casualty surgeon declined to certify the death, the other died at work and was certified in the City Mortuary by the forensic pathologist without coming to the attention of the police casualty surgeon.

Summary of Decisions by Forensic Pathologists

The forensic pathologist carried out post-mortem investigation on all cases of death in hospital that were referred to him and on approximately two-thirds of the cases which died in the community. Deaths which occurred in the community in cases without a previous medical history of coronary heart disease were more likely to proceed to fiscal post-mortem.

The forensic pathologist performed post-mortem investigation on 40% of cases (41 of 102) which had either symptomatic, clinical data or a previous medical history supporting a diagnosis of coronary heart disease ie cases which satisfied the MONICA criteria for coronary heart disease.

D I S C U S S I O N

Ascertainment of Cases

The study investigated the 420 deaths from coronary heart disease in men and women under 65 in Glasgow North of the Clyde, which were recorded by the Registrar General (RG) for Scotland and which give this part of Glasgow its high international coronary mortality rate.

A check on the completeness of the RG data was provided by Mr I Carmichael, former Depute Fiscal for Glasgow, who sent copies of reports for all cases of coronary death which came to his attention. This means of check was partial, because only cases reported to the Glasgow fiscal could be cross-referenced against the RG data, and perhaps not 100% efficient, because it relied on the fiscal office being able to identify cases consistently. However, only one additional case was identified from this source.

Furthermore, a postal questionnaire to Glasgow GPs requesting details of deaths of residents in the study population whilst abroad, and scrutiny of Glasgow hospital discharge data, did not identify any cases which were not contained in the RG data. Although not conclusive, these findings suggest that the RG data provide a satisfactory record of deaths in the study population which were attributed to coronary heart disease.

Investigation of Cases

Each case was investigated using the sources of information used routinely by the Glasgow MONICA Project Office ie procurators fiscal, coroners, hospital records and pathology departments and general practitioners. The level of co-operation from these agencies was high and information was obtained from at least one of the above sources for all but one of the 420 cases. In this case the GP gave permission to access the deceased's records, which had been returned to the Health Board, but they could not be found.

The cases were investigated with a view to ascertaining the proportion of deaths attributed to coronary heart disease which could be substantiated using standardised criteria for myocardial infarction (ie true positives) and the proportion of cases which had been misdiagnosed or for which there was insufficient evidence to support the diagnosis (ie false positives).

No attempt was made to ascertain the proportion of coronary deaths which had been misdiagnosed and appeared in the vital statistics under ICD rubrics other than 410-414 (ie false negatives). For example, the coronary death which was identified from the fiscal records and which appeared in the RG data coded to ICD rubric 485 (bronchopneumonia) was not investigated. Evidence

from previous studies (15, 20) suggests that the net effect of excluding false positive coronary deaths and including false negative coronary deaths is small. It is not possible from the data used in this study to describe this effect in relation to Glasgow's coronary mortality rates. However if there were a high proportion of false negative diagnoses in Glasgow this would paint an even blacker picture of the city's coronary mortality.

The study is not a direct test of the diagnostic decisions of certifying doctors, since not all the data collected may have been available to the doctor, and also, not all of the data known to the doctor may have been collected in this study especially if the data were not written down. For example, it is unlikely that a GP or police casualty surgeon would have had access to ECG/enzyme data for a patient who died shortly after discharge from hospital. However such information would generally only be available for cases which have had an acute coronary event and it may be that the history of the recent illness was the basis of the diagnosis.

Classification of Cases

The high mortality rates are not based on a high proportion of all deaths since the coronary deaths investigated account for only 27% of all deaths (420 of 1,562) in persons aged 25 - 64 in the study population during 1984, suggesting perhaps that over diagnosis of coronary heart disease is unlikely to be the main explanation.

TRUE POSITIVES

86% of the coronary death certificate diagnoses in the study population were substantiated, using the W.H.O. MONICA diagnostic criteria for myocardial infarction ie "definite" or "possible" myocardial infarction. A similiar result was found in the Belfast study (20) where 88% of coronary deaths in persons under the age of 70 were substantiated using the W.H.O. criteria.

The proportion of deaths categorised as "definite myocardial infarction" was greater for deaths which occurred in hospital (45%) compared with those which occurred in the community (18%). However it is important to note that the difference between "definite" and "possible" myocardial infarction categories is dependent more on the circumstances of death and the extent of investigation than the absolute probability of a correct diagnosis.

A "definite acute myocardial infarction" WHO category requires either ECG and/or symptom and enzyme data or post-mortem evidence of acute myocardial infarction or coronary occlusion (Appendix 7). As clinical data are not available for the majority of community deaths the "definite" category can only be met if a post-mortem examination is performed. Even a post-mortem may not provide a "definite" diagnosis since changes of acute myocardial infarction are often not seen in sudden deaths (22,24)*. Using W.H.O. criteria, a probable diagnosis is attributed to coronary heart disease on the basis of post-mortem evidence of a previous myocardial infarction or severe coronary atherosclerosis with narrowing of the coronary arteries. Hence, definite and probable cases are not clearly separated, and the main differentiation is between "Definite/Possible" and "other" categories.

*Footnote

A fresh myocardial infarction or recent coronary occlusion was found in almost two-thirds (64%) of the post-mortems which were performed on cases which died in hospital compared with less than one-half (47%) of the cases which died in the community.

FALSE POSITIVES

57 (14%) of the coronary death certificate diagnoses in the study population could not be substantiated using the the W.H.O MONICA diagnostic criteria for myocardial infarction, and were categorised as "no myocardial infarction" or "unknown". These categories contain cases in which:

(a) the death certificate diagnosis was known to be wrong

11 cases (3% of the total) were identified in which coronary heart disease appeared as the cause of death on the death certificate despite the fact that another diagnosis had been made at death either clinically or at post-mortem. The majority of these cases appeared in the RG data for coronary heart disease because of errors in listing and coding the diagnoses on the death certificate. In one case the diagnosis of coronary heart disease was not ammended despite post-mortem evidence that death was due to acute alcohol intoxication. The certifying doctor may have been unaware of the post-mortem findings, or he may have chosen to disregard the findings in consideration of grieving relatives.

(b) complete data were obtained but the evidence did not support the diagnosis

In 14 cases (3% of total) the information required for the validation exercise (ie symptoms, clinical data and

previous medical history) was obtained but did not meet the criteria for "definite" or "possible" myocardial infarction. The "no myocardial infarction" and "unknown" categories for these cases does not necessarily mean that the certifying doctor did not have a reason for selecting the coronary heart disease diagnosis. For example, in 4 cases there was either clinical or pathological evidence of coronary heart disease but the evidence did not meet the W.H.O. MONICA criteria for definite/possible myocardial infarction. The remaining 10 cases were certified without post-mortem investigation and had no symptoms, clinical data or previous medical history to suppport the diagnosis on the death certificate.

(c) incomplete data were obtained to support the diagnosis

In 32 cases (8% of total) the collection of the information required for the validation exercise was incomplete; in 4 cases the relevant records which detailed the previous medical history could not be obtained and in a further 28 cases information concerning symptoms before death was not recorded. It is possible that the certifying doctor had information for these cases which may have influenced his diagnosis, but as it was not recorded, the information was not available for the validation exercise.

Ways of Reducing the Number of False Positive Cases

Cases with an alternative cause of death.

Possible strategies to increase the proportion of true positive cases in relation to cases for which the death certificate diagnosis was known to be wrong include revising the procedure for completing death certificates so that the certificate is completed or countersigned by a senior clinician responsible for the patient care prior to death (25). This system might not only improve the consistency between the clinical and death certificate diagnoses but also help the Registrar General to follow up cases for which post-mortem results become available after the death certificate has been issued, especially since the address of a junior certifying doctor may have changed by the time these enquiries are made.

Cases without an alternative cause of death.

If there are neither symptoms nor a previous history of coronary heart disease before death, a post-mortem can change the diagnostic category from "no myocardial infarction" or "unknown" to "definite" or "possible myocardial infarction". If there is either a previous medical history or symptoms present (and there is neither a clinical competing cause of death nor a history of "other heart disease") a post-mortem does not materially affect the diagnostic conclusion. For

example, 41 cases which had post-mortem investigation on behalf of the fiscal had symptoms and/or a previous medical history of coronary heart disease. In these cases the post-mortem did not change the diagnostic category from "possible" myocardial infarction to "no myocardial infarction" or "unknown". Therefore, the proportion of "definite/possible" cases (ie true positives) can only be increased by:

1. ascertaining the previous medical history or presence of symptoms in cases with unknown data, and
2. by carrying out post-mortem investigations on-
   (a) cases with neither symptoms nor a previous medical history, and
   (b) cases without symptoms but with a medical history of co-existing coronary heart disease and "other heart disease".

Possible strategies to increase the proportion of true positive diagnoses in cases for which complete data were obtained but the evidence did not support the diagnosis include:

1. referring cases to the fiscal for police investigation if symptoms and previous medical history are not known, or
2. requesting a post-mortem for cases without symptoms or a previous medical history of coronary heart disease, and for cases without symptoms which have a

medical history of co-existing coronary heart disease and valvular heart disease or cardiomyopathy.

Strategies to increase the proportion of true positive diagnoses in cases for which incomplete data were obtained to support the diagnosis include:

1. recording information (if known) on the symptoms and previous medical history, or
2. referring cases to the fiscal so that the police can investigate the case by interviewing witnesses and the general practitioner.

These measures would require a change in the behaviour of different categories of doctors. This may be difficult to achieve if many doctors are involved. However, as the majority of unsubstantiated cases for which an alternative diagnosis had not been made at death were reported to the fiscal, a more practical way of decreasing the number of false positive cases would be for the fiscal to refuse to accept a death certificate issued without post-mortem investigation for cases without symptoms or a previous medical history of coronary heart disease (according to the W.H.O. criteria).

This may not be practical in a local operational context since the processes by which deaths are confirmed and certified are not solely concerned with the accuracy of

the cause of death. Some decisions which control the the disposal of the body are made on the bases of social and legal considerations and since the circumstances of death are varied, the decisions which influence how death is certified can vary from case to case. For example, a body may be removed to the city mortuary and referred to a forensic pathologist for certification because the identity of the GP is unknown or because there is no relative present able to cope with the necessary funeral arrangerments. Therefore the practicality of measures to increase the proportion of substantiated cases should be considered in the context of the circumstances of the death and the existing medico-legal and social systems.

Factors Affecting the Investigation and Certification of Coronary Deaths

The study identified the various medical and legal agencies involved in the process of certification of coronary deaths, under 65 years. Figure 1 illustrates the complexity of the patterns of interaction between these agencies which determined how the deaths were investigated and subsequently certified. However , the figure does not show the total picture. In some cases the role of the procurator fiscal is more passive than active. For example, if the fiscal learns of a case as a consequence of the involvement of a police casualty surgeon, the decision which the procurator fiscal has to make is not whether the case should be referred to the police casualty surgeon or the forensic pathologist for certification but whether to accept the diagnosis of the police casualty surgeon or to request a post-mortem investigation.

This study investigated how some factors, (ie age, sex, place of death, whether death was witnessed, symptomatic and/or clinical evidence and previous medical history), may have affected how cases were certified. A series of simple analyses were carried out in relation to the agencies involved.

THE INVOLVEMENT OF THE AMBULANCE SERVICE

The ambulance service attended 130 of the 296 coronary deaths (44%) which occurred in the community. 88% (115 cases) of cases attended by the ambulance service were known to have suffered a cardiac arrest prior to the arrival of the ambulance ie a maximum of 15 deaths occurred after the arrival of the ambulance or in transit to hospital. The proportion of coronary deaths which might have been prevented by improvement of out-of-hospital coronary care facilities (eg by equipping ambulances with defibrillators and training paramedics) was only 5% of deaths in the community and 4% of all coronary deaths. In order to increase the proportion of cases which might benefit from out-of hospital coronary care facilities the ambulance service would need to attend a higher proportion of patients before cardiac arrest had occurred.

Approximately two-thirds (63%) of the cases which had died prior to the arrival of the ambulance were conveyed to hospital to be confirmed dead by a doctor. The deceased was less likely to be conveyed to hospital if death occurred at home and was not sudden, ie the death was preceded by symptoms.

There may be social or compassionate reasons which influence the decision by ambulance crews to transport the deceased to hospital. For example, grieving

relatives may not want the deceased removed from home if they are aware that death has occurred some time previously.

It is possible that the decision by ambulance crews whether to transport a case to hospital was based on how recently the person was thought to have died ie whether there was any potential for successful cardio-pulmonary resuscitation (CPR). This possibility was not investigated because information on the time intervals between the fatal collapse and the arrival of the ambulance were often not available and the police reports were not a reliable source of information on whether CPR had been attempted. It might be expected that an ambulance would be summoned without delay when death was witnessed and if the response was prompt such cases would taken to hospital whilst CPR was attempted. However, there was no significant difference between the number of cases which were conveyed to hospital or left at the place of death, in relation to whether the death had been witnessed.

Differences in the management of deaths by ambulancemen (ie whether referred to the GP or the police) for cases not taken to hospital are probably explained by the availability of the GP/DDS doctor for confirmation of death. This possible explanation was not investigated

however because the sources of data used in this study did not contain the necessary information.

No differences were identifed between cases referred to the police or to the GP by ambulancemen in terms of whether the death was witnessed or sudden.

THE INVOLVEMENT OF THE POLICE

The involvement of the police in the certification process is incompletely represented in Figure 1 which shows that they were first in attendance at 52 cases of death in the community which were not taken to hospital. In such cases it is the duty of the police as an agent of the procurator fiscal to locate a medical practitioner, usually the GP/DDS doctor, to confirm that death has occurred. If there are no suspicious circumstances the police will ascertain whether the attending doctor is prepared to complete the death certificate. If the GP/DDS doctor cannot be located or declines to attend or is not prepared to issue the death certificate, the police will generally request that a police casualty surgeon atttends to confirm and possibly certify the death. The police are obliged to investigate and submit a report to the procurator fiscal for any case attended by a police casualty surgeon and for all deaths which are not certified.

The police are also involved in all admissions to the city mortuary and report uncertified cases in the mortuary to the forensic pathologist.

Half of the cases first attended by the police and which were not conveyed to hospital were initially referred to a general practitioner and half to the procurator fiscal. There were no differences between the cases referred to the general practitioner or to the fiscal in relation to age, sex, symptoms or area of residence.

The decision to report cases to the fiscal (in some cases as a consequence of the involvement of the police casualty surgeon) may have been determined not by uncertainity as to the cause of death but by the availability of the GP or by legal considerations such as evidence of a possible crime or negligence.

THE INVOLVEMENT OF GPs/DDS DOCTORS

The number of coronary deaths certified by a particular group of doctors does not reflect their total involvement in the certification process.

GPs/DDS doctors were involved in 40% of the coronary deaths but certified only 22%. The majority of deaths (64%) seen by GPs in the community were referred to the fiscal. GPs/DDS doctors were more likely to issue a certificate without referral to the fiscal if there was

a previous medical history of coronary heart disease. The presence or absence of symptoms of coronary heart disease preceding death or witnesses to the death did not appear to influence whether the GP/DDS doctor referred a death to the fiscal.

Another factor which may have influenced the GP/DDS doctor's decision to refer a case to the fiscal is how well the patient was known to the doctor. This factor is difficult to assess because even if the deceased was registered with a particular GP, another doctor from the same practice may be better acquainted with the patient.

Almost one quarter (23%) of all cases certified by GPs were not substantiated. These cases (21 in total) include 7 cases which had been referred to the fiscal, and in which the GP and fiscal had presumably agreed on the cause of death.

2 of the 14 cases which were certified without referral to the fiscal had a previous medical history of coronary heart disease but also had co-existing valvular heart disease or cardiomyopathy which in the absence of symptoms of coronary heart disease before death is interpreted as a competing cause of death according to the W.H.O. criteria for myocardial infarction. In both cases the symptoms before death had not been recorded in the GP notes. The remaining 12 deaths had neither

recorded symptoms nor a history of coronary heart disease prior to death. Most such cases (29 out of 41) were referred to the fiscal by the GP. In all but one of the cases not referred to the fiscal, the symptom status before death had not been recorded in the GP notes. Therefore in 13 of the 14 cases certified by GPs without referral to the fiscal it is possible that the GP had information concerning symptoms prior to death which was not recorded. If the GP had recorded symptoms of coronary heart disease in these cases the proportion of cases which would have been substantiated would have increased by 3%. In the remaining case in which death followed a prolonged epileptic seizure, the only means by which the coronary death diagnosis might have been substantiated would have been for the case to be referred to the fiscal for post-mortem investigation.

THE INVOLVEMENT OF HOSPITAL CLINICIANS

The decisions made regarding the management of deaths which occur in hospital are less likely to be influenced by social factors.

Hospital doctors were involved in 51% of the coronary deaths but certified only 28%. Their involvement in the certification of these deaths varied depending on where the death occurred. For example in 91% of cases which were dead on arrival at hospital, the hospital doctors' only involvement was to confirm that death had occurred.

This is frequently done without removing the deceased from the ambulance. In the remaining 9% of cases which were dead on arrival at hospital, the hospital doctor issued the certificate of cause of death. In the majority of these cases (7 of 8) cardiopulmonary resuscitation had been attempted on arrival at hospital. 97% of the cases which were confirmed dead on arrival at hospital were referred to the fiscal by the hospital doctor. The most likely explanation for the high referral rate to the fiscal of cases which were dead on arrival at hospital is that the cases were confirmed dead in the ambulance and were then taken to the city mortuary as uncertified deaths.

The 3 cases of death on arrival at hospital certified by a hospital doctor without referral to the fiscal had died in transit to hospital. The most likely explanation for the hospital doctor's decision to certify death is that these cases were admitted to the A&E department where CPR was attempted (ie they had received hospital treatment prior to confirmation of death).

30% of coronary heart disease deaths which occurred in hospital patients were referred by hospital doctors to the procurator fiscal. The factor most likely to influence whether a death was reported to the fiscal was the time of survival from admission to hospital.

Virtually all of the deaths (88%) which occurred in A&E departments were referred to the fiscal.

Only 12% of deaths which occurred in general medical wards and 25% of coronary care unit deaths were referred to the fiscal. The difference in referral rates by doctors in these wards probably reflects the fact that most of the deaths within 24 hours of admission occur in CCUs.

The high referral rate for patients who died within 24 hours of admission is not explained by the absence of clinical data to support the diagnosis of coronary heart disease since 43% (6 of 8) of patients without clinical data who died in CCU were not referrd to the fiscal.

The presence or absence of a previous medical history of coronary heart disease did not appear to influence the decision of physcians in these wards to refer a case to the fiscal.

Different factors appeared to determine how hospital deaths were certified in wards other than a general medical ward or a CCU. In these cases the decision to refer the case to fiscal may have been made on the basis of legal considerations in order to exclude misadventure or negligence, rather than because of uncertainty

concerning the cause of death. For example, all deaths which followed an investigative or surgical procedure and one death in which accidental self-poisoning was suspected were referred to the fiscal.

THE INVOLVEMENT OF HOSPITAL PATHOLOGISTS

Hospital pathologists carried out post-mortem examination on 11% of coronary deaths which came to the attention of hospital clinicians. However, only one death certificate was signed by a hospital pathologist. Hospital pathologists are under no legal obligation to issue death certificates for cases which have post-mortem investigation at the request of the hospital clinician. These certificates are generally completed by the clinician who may disregard or be unaware at the time of certification of the post-mortem findings.

The majority of post-mortems (87%) carried out on behalf of the hospital doctor were on cases which had been in-patients at the time of death. The hospital post-mortem rate for cases certified by a hospital doctor was 16% which is similiar to the rate found in a Grampian study (21), where hospital clinicians requested post-mortem investigation on 17% of hospital deaths attributed to coronary heart disease.

A further 13 post-mortems were performed on hospital deaths on behalf of the procurator fiscal. These deaths

were certified by a forensic pathologist. Therefore the total post-mortem rate in the Glasgow population for hospital deaths was 27%. This figure is similiar to that found in the Belfast study (20) where the post-mortem rate for hospital deaths in persons under 70 years was 31%.

The factor most likely to determine whether a case proceeded to post-mortem was the place of death in hospital: 80% of deaths which occurred in wards other than a general medical ward or a CCU and which were certified by a hospital doctor had post-mortem investigation, whereas only 12% of deaths in CCU and 21% of deaths in medical wards certified by the hospital doctor had post-mortem investigation.

Deaths in CCU and medical wards were less likely to proceed to post-mortem if there was evidence of pre-existing coronary heart disease and the death was preceded by symptoms of coronary heart disease.

Virtually all cases (116 out of 118) certified by a hospital doctor had either symptoms, clinical data or a previous medical history of coronary heart disease.

8 of all deaths (7%) certified by a hospital doctor for which all the relevant information was obtained could not be substantiated (ie did not meet the W.H.O.

criteria for myocardial infarction). 5 of these cases would not have appeared in the RG data for coronary heart disease if the clinician had recorded on the death certificate the diagnosis which had been made either clinically or at post-mortem ie the proportion of substantiated cases would increase by 1% if more care had been taken by the hospital clinician in completing the death certificate. The remaining 3 cases were not substantiated, despite a previous medical history of coronary heart disease, because of co-existing valvular heart disease or cardiomyopathy which in the absence of symptoms of coronary heart disease before death is considered a competing cause of death. In these cases post-mortem investigation was required in order to substantiate the diagnosis made at death.

THE INVOLVEMENT OF THE PROCURATOR FISCAL OFFICE

It is the duty of the procurator fiscal to enquire into all sudden, suspicious, accidental, unexpected and unexplained deaths. The fiscal is notified of such cases by the police, hospital doctors, GPs and local registrars of death. 60% of coronary deaths in the study population were reported to the fiscal. The majority of cases (88%) notified to the fiscal were investigated by the police on his behalf. Post-mortem investigation was requested by the fiscal on 44% (118 of 270) of cases. The role of the procurator fiscal in Glasgow obviously extends beyond that of excluding

suspicious deaths in terms of criminality or negligence, though not to the extent of the role of the coroner in the North Staffordshire study (21) who requested post-mortem investigation on all but one of the coronary deaths reported to him in a population under the age of 60 years.

The procurator fiscal has a right and duty to control the disposal of a dead body while he makes enquiries into the death. Depending on the circmstances he may decide to leave the body where death occurred. Alternatively he may decide to have the body removed to a mortuary. In many cases this decision is made by the police or the police casualty surgeon.

Cases of death in the community which were not conveyed to hospital were generally reported to the fiscal as a consequence of the involvement of his agents, the police and police casualty surgeons.

The majority of cases which were confirmed dead on arrival at hospital were reported by the police on behalf of the fiscal to the forensic pathologist. However 7 cases of death on arrival of hospital were certified by the GP, who may do so without viewing the body. In a further 4 cases (3 dead on arrival at hospital and 1 hospital death) the police casualty

surgeon had been invited to complete the death certificate.

The fiscal is required to decide in every case reported to him whether he will accept a medical certificate as to the cause of death or whether a post-mortem is necessary.

THE INVOLVEMENT OF POLICE CASUALTY SURGEONS

Police casualty surgeons were involved in 30% of coronary deaths but certified only 11%. Cases were less likely to certified by a police casualty surgeon if the death was unwitnessed and there were neither symptoms nor a medical history of coronary heart disease before death. It is not possible to tell from the available data whether this was an independent decision by the police casualty surgeon, or a refusal by the fiscal to accept his diagnosis.

5 cases (13%) certified by police casualty surgeons were not substantiated and had neither recorded symptoms nor a previous medical history of coronary heart disease. The police casualty surgeon declined to certify the majority of such cases (40 out 45) which came to his attention. If police casualty surgeons had referred all such cases to the forensic pathologist for possible post-mortem investigation, the proportion of substantiated cases may have been increased by 1%

THE INVOLVEMENT OF FORENSIC PATHOLOGISTS

All cases referred to the forensic pathologist will have had death confirmed by another doctor. In some cases the doctor will have declined to complete the death certificate and in others the fiscal will have decided not to accept the diagnosis of the doctor and will have referred the cases to the pathologist for post-mortem investigation. Police reports do not as a rule contain information on whether another doctor, for example a GP, had proposed to certify death, so it was not possible to identify what proportion of cases were referred to the forensic pathologist by the fiscal specifically for post-mortem investigation.

The 39% of the study deaths which were certified by forensic pathologists represents virtually all cases that came to their attention. There was one exception when a fiscal post-mortem was carried out on a case certified by the GP.

The forensic pathologist performed post-mortems on 70% of cases referred to him. The 100% post-mortem rate for hospital deaths referred to forensic pathologists was probably determined by legal considerations, eg to exclude misadventure or negligence, and the decision to perform a post-mortem examination on these cases may have been made by the fiscal and not the pathologist.

The fiscal accepted the diagnosis made by the forensic pathologist without post-mortem investigation for 32% of the deaths in the community (49 of 151).

In cases of community deaths, a post-mortem was more likely to be performed if there was no previous medical history of coronary heart disease. It is not possible to tell from the available data whether this reflects an indepedent decision by the forensic pathologist or a request by the fiscal that a post-mortem is performed.

19 of all cases (11%) certified by the forensic pathologist were not substantiated. In 8 cases a post-mortem had been performed and either a competing cause of death was found or the post-mortem findings of coronary heart disease did not satisfy the W.H.O criteria.

In the remaining 11 cases a post-mortem was not performed. It is possible that if the forensic pathologist had performed a post-mortem on these cases, the proportion of substantiated cases would have been increased by 3%. One case with a previous medical history of coronary heart disease was not substantiated because of co-existing valvular heart disease which in the absence of symptoms of coronary heart disease before death is considered a competing cause of death. The remaining 10 cases had neither symptoms nor a previous

medical history of coronary heart disease before death to support the diagnosis. The forensic pathologist performed a post-mortem on the majority (61 out of 71) of such cases before certification.

The Fiscal Involvement in False Positive Cases

The fiscal accepted the diagnosis made without post-mortem investigation for a total of 24 cases (6% of all the study deaths) which had neither symptoms nor a previous medical history, according to the W.H.O. criteria. These cases represent 29% (24 of 84) of such cases which came to the attention of the fiscal. 7 deaths were certified by a GP, 5 by a PCS and 12 by a forensic pathologist. For these cases the only means by which the diagnosis might have been substantiated would have been for the fiscal to decline to accept the diagnosis of the certifying doctor and request post-mortem investigation.

Summary of How the Number of False Posiitives Might Be Reduced.

To summmarise, 4% (15) of the study cases were not substantiated either because insufficient data were collected for the validation exercise, or because a wrong diagnosis had been entered on the death certificate and appeared subsequently in the RG data for coronary heart disease.

In the remaining 10% of cases (42) there was insufficient evidence to support the diagnosis made at death according to the W.H.O. criteria for myocardial infarction. In 4 of these cases (1%) there was clinical data or post-mortem evidence of coronary heart disease but the evidence did not meet the W.H.O criteria. In 13 cases the W.H.O. classification may have differed from the GP diagnosis because the GP did not record the relevant information concerning symptoms prior to death. If all these cases did in fact have symptoms, and this had been recorded the proportion of substantiated cases would have increased by 3%. If none of the cases had symptomatic evidence of coronary heart disease, then post-mortem evidence would be required in order to substantiate the diagnosis.

The fiscal did not request post-mortem investigation in 29% (24 of 84) of the community deaths which had neither symptoms nor a previous medical history of

coronary heart disease (ie coronary heart disease without co-existing rheumatic heart disease or cardiomyopathy). In these cases post-mortem evidence of significant coronary heart disease in the absence of other pathology would have changed the diagnostic conclusion from "no myocardial infarction" and "unknown" to "definite" or "possible" myocardial ie would decrease the proportion of false positives cases by up to 6%.

If the fiscal had requested post-mortem investigation only for those cases which did not meet the W.H.O criteria for myocardial infarction, then the number of post-mortems performed by the forensic pathologist in 1984 would have been reduced by 17 cases (15%), from 117 to 100 cases. The reliability of the coronary mortality data could be improved therefore without performing a larger number of post-mortems.

It is possible that there are cases which satisify the criteria for myocardial infarction, but in which a post-mortem investigation would reveal an alternative cause of death, which would exclude the cases from the RG data for coronary mortality. It is not possible from these data to assess whether this is common and therefore whether a policy of performing post-mortem only on cases without symptoms or history of coronary heart disease might increase the number of false positive cases.

The possible effect on the reliability of coronary mortality data of selecting only cases without symptoms or previous medical history for post-mortem investigation could be investigated quite simply. For example, forensic pathologists could record the proportion of cases with symptoms and/or a previous medical history of coronary heart disease in which an alternative cause of death is found at post-mortem. They could also adopt a policy of carrying out a post-mortem in all cases with no symptoms and no previous medical history in order to establish the proportion of cases with pathological evidence of coronary heart disease.

C O N C L U S I O N S

Completeness of Investigation

The exercise to collect retrospectively information on 420 deaths contained in the RG data which give Glasgow its high international rate was successful. Almost complete documentation was obtained for each case and the quality of records obtained was such that a maximum of 8% of cases were not substantiated using the W.H.O criteria for myocardial infarction because relevant information had not been recorded.

The Reliability of Glasgow's Coronary Mortality Data

86% of Glasgow's coronary death certifcate diagnoses were substantiated which compares well with a similiar exercise carried out in Belfast. These results suggest that mortality data based on death certificates are useful tools for comparing coronary mortality rates between these two cities which both have high international rates.

The proportion of cases categorised as "definite" was greater for hospital deaths.

Factors Affecting the Investigation and Certification

The function of the death certificate is not solely concerned with the accuracy of the cause of death. Some decisions which controlled the disposal of the body were made on the bases of legal and social considerations.

The ambulance service attended 39% of the cases which

died in the community. The majority of which had died prior to their arrival. Only two-thirds of these cases were taken to hospital. There was no significant difference between the cases which were taken to hospital and the cases which were left at the place of death in relation to whether death was witnessed.

Each group of doctors, with the exception of the forensic pathologists, had the opportunity to certify substantially more deaths than they did.

Virtually all deaths seen by GPs occurred in the home of the deceased and the majority (64%) were reported to the fiscal. GPs were less likely to refer a case to the fiscal if there was a previous medical history of coronary heart disease.

30% of coronary deaths which occurred in hospital were referred to the fiscal. The factor most likely to determine whether the clinician referred a case to the fiscal (except for deaths in "other" hospital departments) was the time of survival from admission to hospital. Virtually all deaths which occurred in A&E departments were referred to the fiscal. The higher referral rate of deaths in CCUs compared with deaths in general medical ward probably reflects the fact that most deaths within 24 hours of admission occur in CCUs. The presence or absence of a previous medical history or clinical data of coronary heart disease did not influence which cases in these wards were referred to

the fiscal. Coronary deaths which occurred in "other" hospital departments were probably referred to the fiscal because of legal considerations ie to exclude misadventure or negligence.

Post-mortems were performed on 27% of hospital deaths. The majority of post-mortems requested by the hospital doctor were for cases which had been in-patients at the time of death. The majority of coronary deaths which occurred in hospital wards other than a CCU or general medical ward had post-mortem investigation. The deaths in CCU and general medical wards which had post-mortem investigation were less likely to have a previous medical history or symptoms of coronary heart disease.

60% of the study deaths were reported to the fiscal. Of these, the fiscal investigated the majority of deaths which occurred in the community. Hospital deaths, with the exception of those which occurred outwith a general medical ward or CCU, were not investigated by the fiscal.

Police casualty surgeons declined to certify the majority of cases with neither symptoms nor a previous medical history of coronary heart disease which came to their attention.

All hospital deaths and 43% of community deaths investigated by the fiscal had post-mortem investigation by a forensic pathologist. Deaths in the

community were less likely to have post-mortem investigation if there was a previous medical history of coronary heart disease.

Ways of Increasing the Number of Substantiated Cases

In 1% of cases which could not be substantiated there was either clinical or pathological evidence of coronary heart disease which did not meet the MONICA criteria for acute myocardial infarction. In a further 1% of cases the collection of the information required for the validation exercise was incomplete.

The number of substantiated cases would have been increased by 3% if more care had been taken in recording and in coding the diagnoses on the death certificate.

In the remaining 9% (38 cases) which could not be substantiated there were no symptomatic, clinical data, previous medical history or post-mortem evidence to support the diagnosis made at death. These deaths occurred in the community.

In 13 cases the GP did not record information concerning symptoms prior to death. If these cases had symptoms and the information had been recorded, the proportion of substantiated cases might have been increased by up to 3%. If however, there were no symptoms of coronary heart disease then post-mortem evidence would have been required in order to substantiate the diagnosis on the death certificate. Only 1 case was identified which had

been certified by a GP without referral to the fiscal, and for which all the relevant information concerning symptoms and previous medical history had been recorded, but which had no evidence to support the diagnosis made at death. Therefore GPs had the potential for increasing the proportion of substantiated cases by 3% by either recording symptoms (if present), or by referring cases to the fiscal when this information was not known. However it is probably not practicable to alter the practices of such a large group of doctors.

The remaining 6% of cases had been referred to the procurator fiscal who did not request post-mortem investigation. The fiscal and the forensic pathologists probably have the greatest potential role for increasing the proportion of substantiated cases. If the fiscal had requested post-mortem on these cases the post-mortem rate by forensic pathologists would have been increased by 21% (ie from 117 to 141).

However it might be possible to increase the proportion of substantiated cases without increasing the workload of the forensic pathologists by performing post-mortems on only cases without ante-mortem evidence of coronary heart disease. The effect of such a policy in 1984 would have been to reduce the "fiscal" post-mortem rate by 15%. A future study is recommended in order to assess whether the reliability of coronary mortality data might be improved if the forensic pathologists performed post-mortems on a different category of cases.

APPENDICES

List of Appendices.

Counterfoil

Name of deceased

.....

....

Date of Death

.....

Place of Death

.....

.....

Cause of Death

I a.....

b.....

c.....

II .....

.....

P—M *ring* letter A B C

Seen after death *ring figure* 1 2 3

Pregnancy.....

Date of Certification

.....

MEDICAL CERTIFICATE OF CAUSE OF DEATH FORM 11

This certificate is intended for the use of the Registrar of Births, Deaths and Marriages, and all persons are warned against accepting or using this certificate for any other purpose. See back of this form for notes about registration of a death.

To the Registrar of Births, Deaths and Marriages.

I hereby certify that

died at *time* hours on *date* 19

at *place of death*

and that to the best of my knowledge and belief, the cause of death and duration of disease were as stated below.

CAUSE OF DEATH *(Please print clearly)*		Not to be entered in register: Approximate interval between onset and death
I	I	years / months / days
Disease or condition directly leading to death*	a	
	due to (or as a consequence of)	
Antecedent causes Morbid conditions, if any, giving rise to the above cause, the underlying condition to be stated last	b	
	due to (or as a consequence of)	
	c	
II	II	
Other significant conditions contributing to the death, but not related to the disease or condition causing it		

Registrar to enter:
Dist No.
Year
Entry No.

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

Please ring appropriate letter and appropriate figure:—

Certified cause takes account of post-mortem information ..... A
Information from post-mortem may be available later ..... B
Post-mortem not proposed C

Seen after death by me 1
Seen after death by another medical practitioner but not by me 2
Not seen after death by a medical practitioner 3

If deceased was a married woman and death occurred during pregnancy, or within six weeks thereafter, write 'Yes'

Signature

Date 19

Name in BLOCK CAPITALS

Registered medical qualifications

Address

D2(R)
983

D. DEATH—SCOTLAND

COPY No. 2 TO BE SENT TO THE REGISTRAR GENERAL
VITAL STATISTICS BRANCH

A	Year	Month	Day
Date of Registration	88	10	18
District No.		607	
Entry No.		843	
District Name	Glasgow		

Deceased's surname	001	(a)
other name(s)	002	(b)
Sex	Ring appropriate number	Male ....(1) Female....2
Occupation		Status / Industry
Public fund pension or allowance	unemployed.	

Marital Status	Single 1	Married 2	Widowed 3	Divorced 4	Not known 5
Date of birth, and age	Year	Month	Day	Age	
				55 years	

Country of birth: Scotland.

If the deceased was married, widowed or divorced,
(1) If more than once married, full names and occupation of each spouse except the last. 007 (1) —
(2) Last of only spouse's full names and occupation. 003 (2)

Date and time of death	Year	Month	Date	Time
	198			hours

Place of death

Usual residence (if different from place of death) 010

1 Full name of deceased's father 004 (1)
2 his occupation (2)
3 Whether deceased. (3) doc

1 Full name of deceased's mother 006 (1)
2 Surnames of other husbands (2) —
3 Maiden surname 005 (3) (4)
4 Whether deceased

Cause(s) of death?
I (a) myocardial infarction
(b) ischaemic heart disease
(c) Coronary bronchitis.
II

Name of certifying doctor.

Address of certifying doctor.

Name and address of the deceased's own doctor, if different same

Deceased's NHS No.

Informant's relationship to deceased son

Informant's address

I certify that the particulars given above have been supplied by me and that they are true to the best of my knowledge and belief.

Signature of informant 198

Pl of Birth	001
Occupation	3311
St	
Ind	
RD No. of Inst	601
Institution Code	D201N
	231 5LB

Duration of disease		
Years	Months	Days
1		
2		

Post Mortem: 1 2 (3)
S.A.D.: (1) 2 3
Pregnancy
Violence

ICD Code	Nat.Inj.	P of O
410		

Subsidiary Cause

Secondary Codes: 414 9; 491 9; 18

F5

NOTIFICATION OF DEATH

REPORTED BY: DATE:

TIME:

PARTICULARS OF DECEASED –

SURNAME. AGE:

CHRISTIAN NAME(S): DATE OF BIRTH:

ADDRESS:

Glasgow

LOCUS: HOSPITAL:

DATE & TIME: WARD: CCU.

HISTORY: 3wk hist of crescendo angina – lung hist. of perperal vascular disease. Collapsed at home 2100 on arrival home from work – severe chest pains – shortness of breath. GP w DDS referral. Admitted direct to Coronary Care – 1½ hrs. approx after admission arrested. Resus. unsuccessful. GP. DJ HC. NIL SUSP.

CAUSE OF DEATH: 1a MI · b Isch. HD. II. Periph. vasc disease.

CERTIFYING DOCTOR: DJ

PF TO WHOM DEATH REPORTED:

INSTRUCTIONS: No action

BODY RELEASED: E1 ISSUED:

NAME OF POLICE OFFICER INSTRUCTED TO INVESTIGATE: DATE:

TIME:

NAME & ADDRESS OF ANY PERSON INVOLVED IN CAUSE OF DEATH:

Dc 8567937 200 pads 6/82 L P Ltd 240

APPENDIX 4

STRATHCLYDE POLICE

Particulars verified by birth certificate.

REPORT OF SUDDEN DEATH

Station : .....

1. Forenames	2. Surname

3. Sex	4. Age	5. Date of Birth	6. *Single ~~Married~~ ~~Widow(er)~~ ~~Divorced~~	7. Occupation
F	64			Pensioner

8. If married – full name and occupation of spouse

9. Full name and address of next of kin if different from above

10. Usual place of residence of deceased

11. Hour, day, date and place of death	12. Registration district
Between 1000 hours and 1048 hours on Saturday At Glasgow, or enroute in ambulance to the Infirmary, Glasgow.	Glasgow

13. Name, rank or profession of father and whether alive or deceased

Deceased

14. Name and maiden surname of mother and whether alive or deceased

Deceased

15. Cause of death	16. Duration of illness
1(a) HAEMOPERICARDIUM 1(b) RUPTURE OF MYOCARDIAL INFARCTION	

17. Name, address and qualifications of doctor certifying death	18. Name, address of family doctor

19. Hour, day, date and place of ~~burial~~/cremation	20. Name and address of undertaker

21. If death resulted from an industrial accident – name and address of employer and place of work

APPENDIX 4

SUMMARY OF FACTS :

The deceased, , was 64 years of age having been born at Glasgow on , of parentage She never married and resided with her 2 sisters at the address stated. This information was supplied by (sister).

She was on the list of Dr According to Doctor the deceased had no medical history and he only saw her very occasionally at the surgery for minor complaints such as colds. She was last seen by the doctor on for a sore throat when she was prescribed a proprietary brand of throat lozenges. The deceased was not taking any drugs.

About 1000 hours on the deceased returned home after a hairdressing appointment. She sat in the living room with her 2 sisters, witnesses : , and was engaged in general conversation with them. The deceased then slumped over to her left and appeared to be unconscious. Witness telephoned '999' for an ambulance and the police. The ambulance crew, witnesses : attended and attempted to revive her in vain. The deceased was then conveyed by ambulance to the Royal Infirmary, Glasgow. On arrival at the hospital, life was pronounced extinct by and Dr . at 1048 hours. The body was thereafter removed to the City Mortuary, Glasgow.

The death will be registered and the funeral arrangements made by . sister of the now deceased.

There are no suspicious circumstances surrounding the death.

APPENDIX 4

DEPARTMENT OF FORENSIC
MEDICINE AND SCIENCE

TEL: 041-339 8855
EXT: 574
Reference:

THE UNIVERSITY
GLASGOW G12 8QQ

THE CASE OF .

By virtue of a warrant of the Sheriff of Glasgow and Strathkelvin and at the instance of James Tudhope, Esq., Procurator Fiscal at Glasgow, I the undersigned at 9.15 a.m. on , within the City Mortuary, Glasgow, made a post-mortem dissection of the body of . aged 64 years, of , who died on , being declared dead on arrival at the Royal Infirmary, Glasgow.

The body was identified in my presence by:

1.

2.

EXTERNAL EXAMINATION

The body was that of an elderly female 5' 7" and being of an estimated weight of 10 stones. There were no abnormal external characteristics to the body, which was fully rigid and showed post-mortem lividity on the back.

INTERNAL EXAMINATION

Head and Neck

The scalp, skull, meninges, cerebrospinal fluid and brain were healthy, normally developed and intact.

The mouth, nose, tongue, larynx, pharynx and the intrinsic structures of the neck were healthy, normally developed and intact.

Thorax

The trachea contained a small amount of thick, inspissated mucous, but the airway was not necessarily obstructed. Both lungs showed patchy emphysema and some chronic bronchitis in the smaller bronchi.

The pericardial sac was grossly distended by a large quanitity of blood and blood-clot. The cause for the haemorrhage was a rupture on the anterior surface of the left ventricle through a softened myocardial infarction. The remaining chambers were normal. The coronary vessels were all severely affected by atherosclerosis. The myocardial infarction measured approximately 3" x 3". The aorta and major thoracic branches were normal.

A P P E N D I X 4

Abdomen

All the organs were examined in turn and were found to be healthy, normally developed and intact.

Skeleton

Intact.

CONCLUSIONS

This elderly female died from a massive haemorrhage into the pericardial sac from a rupture to a myocardial infarction. This produced a cardiac tamponnade. She died from natural causes.

CAUSE OF DEATH.

1a. HAEMO-PERICARDIUM
1b. RUPTURE OF MYOCARDIAL INFARCTION

Attested on soul and conscience

The University or Glasgow.

APPENDIX 5

Questionnaire 1

GLASGOW MONICA PROJECT CENTRE MONICA NO

NAME
ADDRESS
DATE OF BIRTH DATE OF DEATH
CERTIFIED BY GP
CAUSE OF DEATH PLACE OF DEATH

These questions cover several possible situations. Please answer them as fully as possible.

	CIRCUMSTANCES OF THE FATAL EVENT	RING CORRECT ANSWER
1	Did the patient consult you about acute coronary symptoms in the 28 days before the death?	YES NO
	If YES, was bedrest at home advised	YES NO
	If YES, was outpatient request made	YES NO
	If YES, was there a hospital admission	YES NO
2	Did you attend the patient during the fatal event?	YES NO
3	Was the fatal event witnessed,	YES NO NOT KNOWN
	and if so, by whom?	.....
4	From onset of acute symptoms, how long did the patient survive?	LESS THAN ONE HOUR 1 - 24 HOURS MORE THAN 24 HOURS NOT KNOWN
5	Did the patient have an acute onset pain?	YES NO NOT KNOWN
6	If YES, specify site(s)	CHEST ARM JAW BACK ABDOMEN OTHER
7	If YES, specify duration	UNTIL DEATH UNTIL TREATMENT MORE THAN 20 MINUTES LESS THAN 20 MINUTES
8	If NO, how did attack begin?	ACUTE BREATHLESSNESS SYNCOPE SHOCK FATAL COLLAPSE OTHER ..... NOT KNOWN
9	Were any drugs administered?	YES NO NOT KNOWN
	If YES, please specify	.....
10	Was an ECG recorded during fatal event or in previous 28 days?	YES NO NOT KNOWN
	If YES, may we view it?	YES NO
	If YES, where is it available	.....
11	Was blood taken for cardiac enzymes during fatal event or in previous 28 days?	YES NO NOT KNOWN
	If YES, please detail results	....

APPENDIX 5

12	Was resuscitation attempted?	YES	NO	NOT KNOW
	If, YES who initiated resuscitation?	.....		
13	Was the Fiscal informed?	YES	NO	NOT KNOW
14	Was a post mortem performed?	YES	NO	NOT KNOW

PREVIOUS MEDICAL HISTORY

1	Had the patient had a previous myocardial infarction?	YES	NO	NOT KNOW
	If YES, which year?	.....		
	Which hospital?	.....		
2	Had the patient a previous history of:			
	ANGINA	YES	NO	NOT KNOW
	OTHER ISCHAEMIC HEART DISEASE	YES	NO	NOT KNOW
	VALVULAR HEART DISEASE	YES	NO	NOT KNOW
	CARDIOMYOPATHY	YES	NO	NOT KNOW
3	Was the patient a regular smoker?	YES	NO	NOT KNOW
	If YES, how many?	.....		
4	Was the patient currently employed	.....		
5	Did the patient live alone?	YES	NO	NOT KNOW
		OTHER		
6	Was the patient admitted to hospital in the 28 days before the death?	YES	NO	NOT KNOW
	If YES, which hospital?	.....		
7	Please list patient's			
	Previous Major Illnesses	Regular Medication		
	.....	.....		
	.....	.....		
	.....	.....		
	.....	.....		
8	Are these answers based on	Patient's Notes		Memor

THANK YOU FOR YOUR HELP. SIGNED .....

GP Name .....
(Block Letters)
Address .....

A P P E N D I X 6

Questionnaire 2

Date As Postmark

Glasgow MONICA Project
Queen Elizabeth Building
Royal Infirmary
10 Alexandra Parade
GLASGOW
G31 2ER

MONICA NUMBER

Dear Sirs

NAME
ADDRESS
DATE OF BIRTH
DATE OF DEATH
PLACE OF DEATH
CAUSE OF DEATH

I have no objection to your reviewing the clinical notes of this deceased patient which have been returned to the Primary Care Department of the Health Board.

Yours faithfully

General Practitioner

Practice Stamp

SCOTTISH MONICA

CORONARY REGISTRATION RECORD FORM

This is confidential medical information. If found please return to: Glasgow MONICA Project Centre, Royal Infirmary, Glasgow, G31 2ER. 8

1 Centre code and MONICA number 37

2 Surname Forenames

3 Address

4 Postcode G

Age

5 Date of birth

6 Sex 7 Alternative identification

8 Date of onset Provisional

Confirmed

9 Vital status at 28 days

10 Number of sources

11 Sources of notification 1st Date Diagnosis

2nd Date Diagnosis

3rd Date Diagnosis

12 Hospital number Hosp. code Type of admission

13 Clinical diagnosis Procedure

14 Death certificate diagnosis Secondary

Notes

15 Death certificate institution code

16 Exclusion

17 DIAGNOSTIC CATEGORY Coder

18 Completion date Completed by

19 GP Treatment centre

Address

20 Management

21 Location of episode

22 Procurator Fiscal (No)

23 Post mortem (No)

24 Chunks codes

First

ECG-Enz

Care

Drugs and Procedures

Fatal cases

SEX	ALTERNATIVE IDENTIFICATION	VITAL STATUS AT 28 DAYS	SOURCES
1 Male	1 Yes	1 Alive	1 Hospital
2 Female	2 No	2 Dead	2 SMR 1
9 Not known			3 RG
			4 PI
			5 GP
			6 Other

TYPES OF ADMISSION	EXCLUSION	MANAGEMENT
0 Not admitted	0 Not excluded	1 Hospital
1 Waiting list	1 Already notified	2 Nursing home
2 Transfer	2 Outside age	3 Home
3 Emergency	3 Outside area	4 Medically unattended
4 Elective	4 Diagnosis	5 Other
9 Not known	5 Date of onset	9 Not known
	6 Multiple	

LOCATION	FISCAL	POST MORTEM	CHUNKS CODES
1 MONICA	1 Investigated	1 Yes	1 Yes
2 Other Scotland	2 Notified only	2 Maybe	2 No
3 Other UK	3 Neither	3 No	3 Not applicable
4 Abroad	4 Not relevant	4 Not applicable	4 Not applicable
9 Not known	9 Not known	9 Not known	9 Not known

25 Date key punched Key punched by

SOCIAL STATUS

26 Marital status — 1 Single, 2 Married, 3 Widowed, 4 Other, 9 Not known

27 Occupation — (last job RG code; married women code husband's; single women code own job)

28 Employment status — (from death certificate)

29 Current status — 1 Emp FT PT, 2 Unemp not spec, 3 Unemp seeking work, 4 Unemp unfit, 5 HW, 6 Retd, 9 NK

30 Household status — 1 Owner occupier, 2 Private tenant, 3 Council HA, 4 NFA, 5 Other, 9 NK

31 Household size — 0 NFA, 1 One, 2 Two or more, 8 Institution, 9 NK

32 Country of birth — (from death certificate)

33 Alternative diagnosis

34 Local option

35 Narrative notes

SYMPTOMS

41 Was chest pain present?

42 If yes, 1 < 20 min, 2 Implied duration, 3 > 20 min, 4 Not spec, 8 NR, 9 NK

43 Atypical pain

44 LVF (acute breathlessness)

45 Shock

46 Syncope

1 Yes, 2 No, 8 NR, 9 NK

47 Definite non-cardiac or non-atherosclerotic cause

DIAGNOSTIC CATEGORIES

48 SYMPTOM CODE — Coder

49 ECG CODE

50 ENZYME CODE

51 RESUS CODE — Coder

PREVIOUS MEDICAL HISTORY

52 Previous myocardial infarction — 3 Yes, doc, 5 Yes, undoc, 7 No, undoc, 9 Not recd

53 Date of most recent episode

54 Smoker — 1 Yes, 2 Ex-smoker, 3 Never smoked, 4 Not smoking, not spec, 9 NK

55 Current habit — 1 1-9, 2 10-19, 3 20-29, 4 >30, 5 Cigs NK, 6 Other tobacco, 8 NR, 9 Smoker NK

56 Angina

57 Coronary insufficiency

58 Valvular heart disease

59 Cardiomyopathy

60 Stroke

61 General anaesthetic ≤ 3 days before onset

62 Coronary [illegible] ≤ 3 days before onset

63 Coronary [illegible] 3 days before onset

1 Yes, 2 No, 9 NK

64 IATRO CODE — Coder

65 Medical history data extracted and coded by

17
3

ECGS/ENZYMES

37

71 Number of ECGs ____ No. of ECGs coded ____

NOTES

72 Dates of ECGs in sequence

01	
02	
03	
04	
05	
06	
07	
08	
09	
10	
11	
12	

73 Enter ECG number and codes

ECG No. (01-12)	Cal	Suppression Code	1 Codes Q QS			4 Codes STD			5 Codes T			3-2 Codes STE		
			I aVL V6	II III aVf	V1 to V5	I aVL V6	II III aVf	V1 to V5	I aVL V6	II III aVf	V1 to V5	I aVL V6	II III aVf	V1 to V5

74 ECG CODE ____ Coder ____

75 Number of cardiac enzyme estimations ____

76	Date	CPK	AST	LDH	Other cardiac	ALT liver
1						
2						
3						
4						
	Upper limit for laboratory					

77 Liver diseases and or alcohol and or drug abuse

78 Defibrillation - 3 days before abnormal enzymes

79 Other causes of tissue necrosis - 3 days before abnormal enzymes

1 Yes
2 No
3 Not relevant
9 Not known

80 ENZYME CODE ____ Coder ____

MEDICAL CARE

3 7

91 Place of onset

01 Work
02 Home
03 Other private place
04 Public place
05 Elsewhere
09 NK outside hosp
10 A & E
11 CCU
12 General ward
13 Other hosp dept
77 Hospital not known
88 NR 99 NK

92 Onset
93 First recorded call to medical services
94 Initial medical care
95 First cardiopulmonary resuscitation
96 Arrival at A & E department
97 Arrival on ward
98 First defibrillation

E | DATES | TIMES

E Codes
1 Reliable
2 Interpolated
3 Estimated
4 Added
8 Not relevant
9 Not known

99 Time from onset to initial medical care

1 < 5 min
2 5-59 min
3 60-119 min
4 2-4 hr
5 4-24 hr
6 ≥ 24 hr
7 Not known but prob. < 24 hrs.
8 Not relevant
9 Not known

100 First medical contact

1 GP surgery
2 GP at home
3 Deputy at home
4 GP sent amb
5 Self ref. to A E
6 NK if 4 or 5
7 Other doctor
8 Not relevant
9 Not known

101 Initial care given by

1 GP Deputy
2 MCCU
3 Other Dr. outside hosp.
4 Hospital
8 Not relevant
9 Not known

102 Initial management

1 At home
2 Referred OP clinic
3 Request ECG
4 A E or admit
5 Pt. refused
6 In hospital
8 Not relevant
9 Not known

103 Transport to hospital

1 Ambulance
2 MCCU
3 Private
4 Public
5 Foot
8 Not relevant
9 Not known

104 Type of hospital care

1 MCCU
2 MCCU + CCU
3 MCCU - ward
4 CCU
5 Medical ward
6 A & E only
7 Other
8 Not relevant
9 Not known

105 Number of whole days in coronary care unit

00 < 24 hr
88 Not relevant
99 Not known

106 Did apparent cardiac arrest occur outside hospital?

1 Yes
2 No
8 Not relevant
9 Not known

107 If so, was CPR attempted outside hospital?

1 Yes
2 No
8 Not relevant
9 Not known

108 Initial CPR given by

1 Bystander
2 GP
3 MCCU
4 Ambulance
5 Other medic
6 Hospital
7 Bystander - GP advised by mobile team
8 Not relevant
9 Not known

109 Was CPR attempted on arrival in hospital?

1 Yes
2 No
8 Not relevant
9 Not known

110 Did apparent cardiac arrest occur in hospital?

1 Yes
2 No
8 Not relevant
9 Not known

111 Was CPR attempted after cardiac arrest in hospital?

1 Yes
2 No
8 Not relevant
9 Not known

112 First recorded systolic BP after onset

000 No pressure
888 Not relevant
999 Not known

113 What was maximum recorded pulse rate during the first 24 hours of care?

888 Not relevant
999 Not known

114 Date of discharge

115 Data extracted and coded by

DRUGS AND PROCEDURES

3 7

121 Number of drugs prescribed before onset

122 Number of drugs injected outside hospital

123 Number of drugs prescribed during episode

124 Number of drugs prescribed on discharge

125 Number of procedures before onset

126 Number of procedures during episode

127 Number of procedures recorded on discharge

Codes for drugs

01 Analgesic
02 Antiarrhythmic (not beta blocker)
03 Beta blocker
04 Inotropic
05 Anticoagulant
06 Antiplatelet
07 Streptokinase (other thrombolytic)
08 Diuretic
09 Calcium blocker
10 Nitrates
11 Other antihypertensive
12-15 Future drugs
16 rPA/ HRT
19 Other drugs not codable

Codes for procedures

30 Coronary angiography
31 Scintigraphy (isotopes)
32 CABG
33 Pacing
34 Angioplasty
35 Balloon pump
36 Formal rehabilitation (graded exercise)
37-39 Future procedures
49 Other procedures not codable

FATAL CASES

37

141 Date and time of death

142 Death witnessed
1 Yes
2 No
9 No information

143 Death certificate signed by
1 GP partner trainee
2 Police surgeon
3 Pathologist
4 Hospital doctor
5 Other
9 Not known

144 Place of death
01 Work
02 Home
03 Private address
04 Public place
05 Outside hospital
06 In transit
09 Not known, outside hospital
10 A+E
11 CCU
12 General ward
13 Other hosp dept
19 Not known in hospital
99 Not known

145 Apparent survival time
1 < 1 hour
2 1–24 hr
3 ≥ 24 hr
4 probably < 24h
5 probably > 24h
9 Not known

146 Post mortem status
1 Complete
2 Incomplete
4 None
9 Not known

147 Post mortem performed by
1 Hospital elective
2 Fiscal
3 1 + 2
8 Not relevant
9 Not known

148 Post mortem cardiac findings

149 Post mortem findings

150 NECROPSY CODE

Coder

151 Fatal case data extracted by

152 Notes

160 Centre code and MONICA number 37

161 Previous centre code and MONICA number

162 NHS number

APPENDIX 8

C. Decisions by the General Practitioner

Table C.1 Breakdown of cases seen by GPs by witness to death and whether referred to the fiscal.

	Witnessed	Not Witnessed	Not Known	Total
Referred to the Fiscal	43	62	3	108
Not Referred	20	12	30	62
Total	63	74	33	170
% Referred	68	84	9	64

Null hypothesis

There is no association between the decision to refer a cases to the fiscal and the presence of a witness to the death.

$x^2 = 1\text{-}54$, 1d.f., $p > 0\text{-}10$

Conclusion:

The hypothesis is accepted.

Comment:

There is probably no association between the decision to refer a cases to the fiscal and the presence of a witness to the death.

APPENDIX 8

C. Decisions by the General Practitioner

Table C.2 Breakdown of cases seen by general practitioners by symptoms of myocardial preceding death infarction and whether referred to the fiscal.

	Symptoms	No Symptoms	Total
Referred to the Fiscal	50	58	108
Not Referred	26	36	62
Total	76	94	170
% Referred	66	62	64

Null Hypothesis

There is no association between the decision to refer a case to the fiscal and the presence of symptoms of myocardial infarction preceding death.

$x^2 = 0\text{-}15$, 1 d.f., $p > 0\text{-}50$

Conclusion:

The hypothesis is accepted.

Comment:

There is probably no association between the decision to refer a case to the fiscal and the presence of symptoms of myocardial infarction preceding death.

APPENDIX 8

D. Decisions by hospital doctors

Table D.3 Breakdown of cases seen by CCU doctors by previous medical history of coronary heart disease and whether referred to the fiscal.

	PMH	no PMH	PMH unknown	Total
Referred to fiscal	11	3	1	15
Not referred	26	15	3	44
Total	37	18	4	59
% Referred	30	17	75	25

Null Hypothesis

There is no association between the decision to refer a case to the fiscal and presence of a known medical history of coronary heart disease.

$x^2 = 0{\cdot}46$, 1 d.f., $p > 0{\cdot}10$

Conclusion

The hypothesis is accepted.

Comment

There is probably no association between the decision to refer a case to the fiscal and the presence of a known history of coronary heart disease.

APPENDIX 8

D. Decisions by hospital doctors

Table D.5 Breakdown of deaths in general medical wards by survival from admission and whether referred to the fiscal.

	Died within 24hrs	Died after 24hrs	Total
Referred to fiscal	4	1	5
Not referred	9	27	36
Total	13	28	41
% Referred	31	4	12

Null hypothesis

There is no association between the decision to refer a case to the fiscal and the survival time from admission to a general medical ward.

$p = 0 \cdot 284$

Conclusion

The hypothesis is accepted.

Comment

There is probably no association between the decision to refer a case to the fiscal and the survival time from admission to a general medical ward.

APPENDIX 8

E. Decisions by hospital doctors

Table E.2 Breakdown of deaths certified by hospital doctors by symptoms of myocardial infarction preceding death and whether post-mortem was performed.

	Symptoms	No Symptoms	Total
Post-mortem	18	5	23
No Post-mortem	82	13	95
Total	100	18	118
% Post-mortem	18	28	19

Null hypothesis

There is no association between the decision to perform a hospital post-mortem and the presence of symptoms of myocardial infarction preceding death.

$x^2 = 0{\cdot}41$, 1d.f., $p > 0{\cdot}05$

Conclusion

The hypothesis is accepted.

Comment

There is probably no association between the decision to perform a hospital post-mortem and the presence of symptoms of myocardial infarction preceding death.

APPENDIX 8

E. Decisions by hospital doctors

Table E.4 Breakdown of deaths certified by hospital doctors by the availability of clinical data for myocardial infarction and whether post-mortem was performed.

	Cinical data	No clinical data	Total
Post-mortem	15	8	23
No-postmortem	63	32	95
Total	78	40	118
% Post-mortem	19	20	19

Null Hypothesis

There is no association between the decision to perform a hospital post-mortem and presence of clinical data for myocardial infarction.

$x^2 = 0{\cdot}02$, 1 d.f., $p > 0{\cdot}50$

Conclusion

The hypothesis is accepted.

Comment

There is probably no association between the decision to perform a hospital post-mortem and the presence of clinical data for myocardial infarction.

APPENDIX 8

H. Decisions by the police casualty surgeon

Table H.2 Breakdown of cases seen by the police casualty surgeon by witness to death and whether referred to the forensic pathologist.

	Witnessed	Not Witnessed	Total
Referred to F.PATH	24	55	79
Not Referred	21	22	43
Total	45	77	122
% Referred	53	71	65

Null hypothesis

There is no association between the decision to refer a case to the forensic pathologist and the presence of a witness to the death.

$x^2 = 3{\cdot}32$, 1 d.f., $p > 0{\cdot}05$

Conclusion

The hypothesis is accepted.

Comment

There is probably no association between the decision to refer a case to the forensic pathologist and the presence of a witness to the death.

APPENDIX 8

H. Decisions by the police casualty surgeon

Table H.3 Breakdown of cases seen by the police casualty surgeon by symptoms of myocardial infarction preceding death and whether referred to the forensic pathologist.

	Symptoms	No Symptoms	Total
Refer to For.Path	27	52	79
Not referred	21	22	43
Total	48	74	112
% Referred	56	70	65

Null Hypothesis

There is no association between the decision to refer a case to the forensic pathologist and the presence of symptoms of myocardial infarction preceding death.

$x^2 = 2{\cdot}23$, 1 d.f, $p > 0{\cdot}10$

Conclusion

The hypothesis is accepted.

Comment

There is probably no association between the decision to refer a case to the forensic pathologist and the presence of symptoms of myocardial infarction preceding death.

APPENDIX 8

I. Decisions by forensic pathologists

Table I.2 Breakdown of cases certified by the forensic pathologist by witness to death and whether post-mortem investigation was performed.

	Witnessed	Not Witnessed	Total
Post-mortem	42	60	102
No Post-mortem	23	26	49
Total	65	86	151
% Post-mortem	64	70	68

Null hypothesis

There is no assocation between the decision to perform a post-mortem and the presence of a witness to the death.

$x^2 = 0 \cdot 24$, 1 d.f., $p > 0 \cdot 50$

Conclusion

The hypothesis is accepted.

Comment

There is probably no assocation between the decision to perform post-mortem and the presence of a witness to the death.

APPENDIX 8

I. Decisions by forensic pathologists

Table I.3 Breakdown of cases certified by the forensic pathologist by symptoms of myocardial infarction preceding death and whether post-mortem investigation was performed.

	Symptoms	No Symptoms	Total
Post-mortem	36	66	102
No Post-mortem	14	35	49
Total	50	101	151
% Post-mortem	72	65	68

Null hypothesis

There is no association between the decision to perform a post-mortem and the presence of symptoms of myocardial infarction before death.

$x^2 = 0 \cdot 41$, 1 d.f., $p > 0 \cdot 50$

Conclusion

The hypothesis is accepted.

Comment

There is probably no association between the decision to perform a post-mortem and the presence of symptoms of myocardial infarction preceding death.

APPENDIX 9

April 1984

DIAGNOSTIC CRITERIA FOR CORONARY AND STROKE EVENTS
(to be read with Chapters 10 and 11)

CORONARY EVENTS

The diagnostic classification is similar to that used in the WHO Myocardial Infarction Registers. However, the diagnostic criteria for these were based on the Annex to the first report of the Expert Committee on Cardiovascular Diseases and Hypertension(8) which antedated publication of the Minnesota code (7) and consisted of qualitative rather than quantitative criteria. The Myocardial Infarction Registers criteria have been modified therefore (I) to make them more quantitative and take account of the Minnesota code, (II) to take account of the "diagnostic criteria for myocardial infarction and stroke for use in community surveillance studies in the United States" being developed for the Committee on Criteria and Methods of the Council on Epidemiology of the American Heart Association and (III) to include death from chronic manifestations of coronary heart disease.

1. Symptoms

At the onset of the present attack:

1.1 Typical - when chest pain is present, characterized by:
(I) duration of more than 20 minutes AND
(II) no definite non-cardiac cause.

Note: Other characteristics are used clinically but as these are not always present they cannot be used in a definition.

If the duration of the pain is not specified in minutes or hours but there is some description implying that duration was long (such as the use of adjectives like prolonged or continuous, or the pain lasted while other events took place such as death, summoning of help, arrival of medical care or injection of analgesic) then the pain can be coded as typical.

1.2 Atypical
(I) one or more of the following
- atypical pain
- acute left ventricular failure
- shock
- syncope

AND
(II) the absence of cardiac disease other than ischaemic heart disease
AND
(III) no definite non-cardiac cause.

Note: Atypical pain would be that recorded as of short duration, or intermittent with each bout lasting for less than 20 minutes, or in an unusual site (upper abdomen, arms, jaw, neck).

Fatal collapse should not be considered as syncope or all sudden deaths would be so coded. Syncope should be reversible. Typical chest pain leading to syncope should not be coded as atypical.

1.3 Other

Symptoms not satisfying criteria for Typical, Atypical or inadequately described.

APPENDIX 9

1.4 None
Complete absence of symptoms in the attack (eg sudden death)

1.5 Inadequately described
Cases otherwise satisfying criteria for Typical pain in which the duration of the pain is not described so that it is not possible to classify it as Typical or Atypical.

1.9 Not Known
No information on whether symptoms were present.

For diagnostic classification 2 is equivalent to 5
3, 4 and 9 are equivalent to each other.

2. Electrocardiogram

The ECG classification will be based on the reading of records taken in the period following the acute attack and, if available, records taken immediately before (i.e. within the previous 28 days). Up to four records should be selected for coding of change and the choice should be standardized. The following is a recommendation:

First available ECG in the attack (or one from immediately beforehand)
The next 2 with different dates from the first and from each other.
The last available in the record file of the admission.

Local discretion to be used if:

One or more records specified above are uncodeable and codeable records are available. OR

Acute progressive changes occur later in the period of surveillance (e.g. late inversion of T waves in the presence of ST elevation)

It is recommended that photostats of ECGs should be obtained wherever possible.

ECGs should be coded individually using a combination of the MONICA Protocol criteria and the Minnesota Code Manual of Electrocardiographic Findings, plus a transparent ruler and a coding lens. Each record should be coded individually for Minnesota 1, 4, 5, and 9.2 codes within lead groups (anterolateral I,aVL, V6; posterior (inferior) II,III and aVF; and anterior V1,V2,V3,V4,V5) and for suppression codes. The standard procedure will be that a written record is kept of individual codes as a method of quality control for duplicate coding and so that the MONICA ECG classification can be derived by inspection of the sequence of codes. A computer algorithm is feasible using changes within lead groups to generate a MONICA ECG classification. The MONICA criteria are therefore based on the sequence of individual codes as described here; and without applying the criteria for significant serial change described in the Minnesota Code Manual. The ECG records as a whole should be coded to the most severe class applicable. If in doubt code to the less severe alternative.

2.1 Definite ECG

(A) The development in serial records of a diagnostic Q wave
(as characterized below)
-AND/OR-
(B) The evolution of an injury current which lasts more than one day.
(as characterized below)

APPENDIX 9

(note: criterion B is included because diagnostic Q waves are already present in the first ECG recording in many cases. The presence of Q waves is not necessary to satisfy this criterion)

The interpretation of a minimum of two or sometimes three ECG records is therefore necesssary for the establishment of these categories. (Not more than four to be coded. Four should be coded ideally if they are available.)

A. Development of Q waves

Progression of Q codes from no Q to a diagnostic Q is sufficent but change from no Q to an equivocal Q or from equivocal to diagnostic Q must be accompanied by deterioration in the ST segment or the T wave. A change in a Q code or in a 4, 5 or 9-2 code must occur within the same lead group but the Q can be in a different lead group to that in which the 4, 5 or 9-2 code is being followed. Note that Minnesota code 1-2-6 is equivalent to No Q code.

I) No Q or QS code in the first ECG record followed by a record with a diagnostic Q or QS code (Minn. code 1-1-1 through 1-2-5 plus 1-2-7)

-OR-

II) An equivocal Q or QS code (Minn. code 1-2-8 or any 1-3 code) and no major ST segment depression (No Minn. code 4-1 or 4-2) in the first ECG record followed by a record with a diagnostic Q code PLUS a major ST segment depression(Minn. code 4-1 or 4-2)

-OR-

III) An equivocal Q finding and no ST segment elevation (No Minn. code 9-2) in the first ECG record followed by a record with a diagnostic Q code PLUS an ST segment elevation (Minn. code 9-2)

-OR-

Iv) An equivocal Q finding no major T wave inversion (No Minn. code 5-1 or 5-2) in the first ECG record followed by a record with a diagnostic Q code PLUS a major T inversion(Minn.code 5-1 or 5-2)

-OR-

v) No Q code and neither 4-1 nor 4-2 in the first ECG followed by a record with an equivocal Q code plus a 4-1 or 4-2

-OR-

vi) No Q code and no 9-2 in the first ECG followed by a record with an equivocal Q code plus a 9-2

-OR-

vii) No Q code and neither 5-1 nor 5-2 in the first ECG followed by a record with an equivocal Q code plus a 5-1 or 5-2

-OR-

B. Evolution of an injury current which lasts more than one day.

viii) An ST segment Elevation (Minn. code 9-2) lasting more than one day (i.e. present on consecutive records of different dates)

AND

T wave progression on three or more records from 5-0 to 5-2 or from 5-3 to 5-1, with a more abnormal code present on consecutive records of different dates.

Note: The ST segment elevation does not have to be present in the same lead

APPENDIX 9

groups as the T progression, nor does it have to be exactly simultaneous. Q waves will often be present in the same graphs but they are not necessary to the use of this criterion for Definite ECG.

2.2 Probable ECG

Evolution of repolarisation changes

I) No major ST segment depression in one ECG record (no 4-1 or 4-2) and another record with a major ST segment depression (Minn. code 4-1)

II) No ST segment elevation in one ECG record (no 9-2) and another record with an ST segment elevation (Minn. code 9-2)

III) No major T wave inversion in one ECG record (no 5-1 or 5-2) and another record with a major T wave inversion (Minn. code 5-1 or 5-2)

Note: Unlike the criteria in the previous classes, the evolution in this class can go in either direction, that is the codes can get better or worse.
Note also that the criteria are not identical to those for repolarisation criteria accompanying the Q classes II) to VII) in that the 4 code is more severe; the development or disappearance of 4-2 does not qualify; it has to be a 4-1.

2.3 Ischaemic ECG (in one or more records)

Records not satisfying the above criteria which nonetheless show:

I) Minnesota codes 1-1-1 to 1-3-6 excluding 1-2-6 for Q and QS codes.

-AND/ OR-

II) Minnesota codes 4-1 through 4-3 for ST junction (J) and segment depression.

-AND/OR-

III) Minnesota codes 5-1 through 5-3 for T wave items.

-AND/OR-

Iv) Minnesota code 9-2 for ST segment elevation.

2.4 Other ECG

All other ECG findings, including normal ECG but note rules for uncodable ECG below.

2.5. Uncodable ECG

This class should be used where all the available ECG records taken in

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the attack are uncodable for technical reasons or because of the presence of suppression codes. Records in which suppression codes permit certain Q codes to appear could be used to diagnose the development of a diagnostic Q code from no Q code (MONICA category 2.1A 1) or to allocate the code of ischaemic ECG (MONICA category 2.3); supporting evidence from 4, 5, and 9-2 codes are needed for all other MONICA ECG classes. Therefore, unless codable Q waves are present leading to the diagnostic or ischaemic category, and unless at least one ECG is available that can be coded for 1,4,5 and 9-2 items then the presence of suppression codes or technically unsatisfactory records should lead to the allocation of the classification "uncodable". The implications of this rule are that ventricular conduction abnormalities and arrythmias occurring in the course of an event are not used as collateral evidence of ischaemia.

The following Minnesota codes lead to suppression of all or most of these items, and a set of ECG records in which such findings are present in all records should be considered uncodable (unless codable Q waves are present, for example in an ECG showing a 7-4)

6-1	Third degree A-V block suppresses all 1,4,5 and 9-2.
6-4-1	Persistent Wolff-Parkinson White Pattern suppresses all other codes.
6-8	Artificial pacemaker suppresses all other codes.
7-1-1	Complete left bundle branch block suppresses 1-2-3,1-2-7,1-2-8,1-3-2, 1-3-6 and all 4, 5 and 9-2 codes but the presence of a codable Q downgrades it to 7-4.
7-2-1	Complete right bundle branch block suppresses 1-2-8, and all 4, 5 and 9-2 codes.
7-4	Intraventricular block suppresses all 4, 5, and 9-2 codes.
8-2-1	Ventricular fibrillation and asystole suppress all other codes
8-2-2	Idioventricular rhythm suppresses all other codes.
8-4-1	Supraventricular tachycardia above 140/minute suppresses all other codes.

2.6 ECG absent

No ECG available or recorded.(Coded as 9, no data)

3. Cardiac enzymes

Appropriate serum cardiac enzymes tests will be used whenever possible. Owing to differing local laboratory circumstances it will not be possibel for this study to standardise the serum enzymes tests nor the reagents and methods employed. Each centre should, in cooperation with each local laboratory, define (1) the tests employed, and (2) local ranges of normal, equivaocl and abnormal.

Abnormal: At least one serum enzyme level is more than twice the limits of normal when measured within 72 hours of onset of symptoms or admission.

Equivocal: Serum enzyme levels are raised but to less than twice the

upper limits of normal.

Non-specific: Serum enzyme levels are raised above normal but there are probable explanations other than cardiac infarction, such as liver disease, infections, defibrillation as in cardiac arrest or surgery.

Incomplete: Tests not done within 72 hours of onset of symptoms or admission.

Normal: Within normal limits.

4. Necropsy findings

The results of post-mortem examination which are recorded in the following section of data requirements for death provide the information for classification into:

Definite evidence of acute myocardial infarction: the presence of a fresh myocardial infarction and/or recent occlusion of a coronary artery (from ante-mortem thrombus, haemorrhage into an atheromatous plaque or embolism).
Note that this refers to the naked-eye appearance of the heart.

Equivocal: signs of chronic ischaemic heart disease, namely old myocardial infarction (scar), occlusion or severe stenosis (greater than 50% reduction of lumen) by atheroma of one or more coronary arteries in the absence of fatal disease outside the heart.

Negative: (a) the absence of macroscopic evidence of fresh myocardial infarction or recent occlusion of the coronary artery or (b) evidence of fatal disease outside the heart in the presence of ischaemic heart disease.

5. Diagnostic categories

There are the following categories:

(1) definite acute myocardial infarction
(2) possible acute myocardial infarction or coronary death
(3) ischaemic cardiac arrest with successful resuscitation not fulfilling criteria for definite or possible myocardial infarction
(4) no acute myocardial infarction or coronary death
(5) fatal cases with insufficient data.

Allocation of a diagnostic category must follow strictly the definitions provided. The categories used for the diagnosis of "definite" and "possible" acute myocardial infarction are not necessarily those that would be used by a clinician, but rigid definitions are essential for event analysis.

(1) Definite acute myocardial infarction

(a) Definite ECG or
(b) Symptoms typical or atypical or inadequately described, together with probable ECG and abnormal enzymes, or

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(c) Symptoms typical and abnormal enzymes with ischaemic or non-codable ECG or ECG not available, or

(d) Fatal cases, whether sudden or not, with naked-eye appearance of fresh myocardial infarction and/or recent coronary occlusion found at necropsy.

(2) Possible acute myocardial infarction or coronary death

(a) Living patients : with typical symptoms whose ECG and enzyme results do not place them in category (1) and in whom there is no good evidence for another diagnosis for the attack, or

(b) Fatal cases whether sudden or not (not in category 1) where there is no good evidence for another cause of death, clinically or at autopsy:S

(I) with symptoms typical or atypical or inadequately described; or

(II) without typical or atypical or inadequately described symptoms but with evidence of chronic coronary occlusion or stenosis or old myocardial scarring at necropsy; or

(III) with a good history of chronic ischaemic heart disease such as definite or possible myocardial infarction, or coronary insufficiency or angina pectoris in the absence of significant valvular disease or cardiomyopathy.

NOTE: A strict watch should be kept over competing causes of death. Local rules should be standardized and record kept of difficult decisions.

(3) Ischaemic cardiac arrest with successful resuscitation not fulfilling criteria for definite or possible myocardial infarction. Spontaneous cardiac arrest not provoked by medical intervention, electrocution, drowning or other gross physical insults, from presumed primary ventricular fibrillation secondary to ischaemic heart disease, in the absence of significant valvular disease or cardiomyopathy.

(4) No acute myocardial infarction

(a) Living patients (not in category (1))

(I) probable, non-evolving, other, uncodable, and absent ECG without typical symptoms or elevated enzymes, or

(II) where illness episode has been explained by another diagnosis.

(b) Fatal cases, whether sudden or not, not in category (1) where another diagnosis has been made (clinically or at autopsy).

NOTE: A strict watch should be kept over competing causes of death. Local rules should be standardized and a record kept of difficult decisions.

(5) Fatal cases with insufficient data

Cases with no autopsy, no history of typical or atypical or inadequately described symptoms, no previous history of chronic ischaemic heart disease and

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no other diagnosis. Living patients should not be allocated to this category. It is hoped that most centres will not need this category.

CEREBROVASCULAR STROKE EVENTS

Definition of stroke

Stroke is defined as rapidly developed clinical signs of focal (or global*) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than a vascular origin: it includes patients presenting clinical signs and symptoms suggestive of subarachnoid haemorrhage, intracerebral haemorrhage,or cerebral ischaemic necrosis. It does not include transient cerebral ischaemia.

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* "Global" - applies to patients with subarachnoid haemorrhage and to some patients in deep coma, but does not include systemic circulatory failure, e.g. shock, Stokes-Adams syndrome, or hypertensive encephalopathy.

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Figure I.2 Clinical data available for cases certified by the forensic pathologist without post-mortem investigation.

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