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THE RELIABILITY OF HEART DISEASE DIAGNOSIS ON DEATH CERTIFICATES

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THE RELIABILITY OF HEART DISEASE DIAGNOSIS

ON DEATH CERTIFICATES

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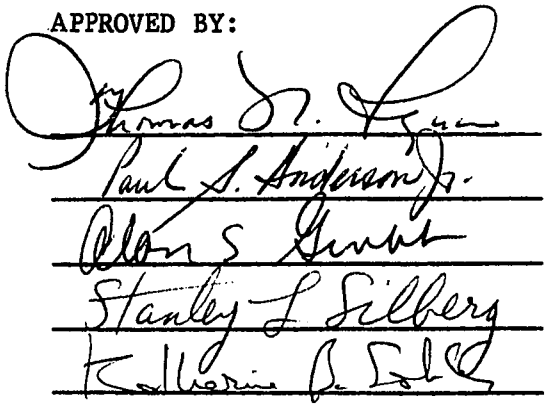

DISSERTATION COMMITTEE

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TO:

Leila and children

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CHAPTER I

INTRODUCTION

Except for some population surveys, the assessment of public health importance of cardiovascular-renal disease has been based almost entirely on mortality statistics (Moriyama et al., 1971). The medical literature contains many studies analyzing deaths attributed to cardiovascular diseases but few concerned with the reliability of these diagnoses on the death certificates.

The World Health Organization (WHO) Expert Committee on Health Statistics (1950) emphasized the importance of studies designed to evaluate the reliability of diagnoses entered on death certificates. The Committee realized that for various reasons, the diagnoses of causes of death on death certificates formed an insecure foundation upon which to build knowledge relative to the frequency of diseases. Aase (1960) reported that approximately 20 per cent of all records in the files of the Bureau of Vital Statistics contain errors or omissions.

Many who use national mortality data complain that they are of limited value but do not check their reliability and yet continue to use the data and to draw (tentative) conclusions. Attempts to validate

such data have been made from time to time but usually the requirement for doing so has been lacking (Barclay, 1966; Kagan et al., 1967a; and 1967b). They also reported that, although it is generally stated that the national mortality statistics are to some extent unreliable, it is difficult to ascertain their degree of unreliability.

It is therefore felt that a critical assessment of the present standards of death certificate diagnosis of cause of death of heart disease would be a worthwhile study. This study will consist of two parts. The first and principal part of this dissertation is devoted to the estimate of the degree of reliability of the cause of death statement on the death certificates of patients said to have died from one of three categories of heart disease, i.e., Ischemic Heart Disease (IHD), Hypertensive Heart Disease (HHD) and Chronic Rheumatic Heart Disease (CRHD). These three categories constituted more than 95 per cent of the total reported heart disease mortality in Oklahoma City in 1969[1]. The second part includes the descriptive epidemiological analysis of all death certificates which listed a form of heart disease as the cause of death for Oklahoma County residents, who died between January 1, 1966 and December 30, 1970.

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[1]According to preliminary report of Division of Vital Statistics of Oklahoma State Department of Health.

CHAPTER II

REVIEW OF LITERATURE

The review of the literature includes the main areas which are related to this study.

Reliability of Cause of Death Statement on the Death Certificate

There are a few studies primarily concerned with the reliability of heart disease diagnoses on death certificates. There have been, however, several studies which included heart disease among the diagnoses tested. The studies which have been concerned with the reliability of statements concerning the underlying cause of death from heart disease may be described by the methods of their studies.

Summaries of autopsy findings have been compared with clinical diagnoses to measure and describe areas of clinical diagnostic error. In such a study of 3,000 autopsies, Cabot (1912) found that for some causes of death, there were more inaccuracies than for others. In his study, the percentage of correct diagnoses ranged from 95 per cent for diabetes mellitus to as low as 16 per cent for acute nephritis. The heart diseases which were included in Cabot's study were: aortic regurgitation with 84 per cent correct diagnoses; mitral stenosis, 69 per cent; aortic stenosis, 61 per cent; acute endocarditis, 39 per cent; chronic myocarditis with 22 per cent and acute pericarditis, 20 per cent.

James et al. (1955), in a study of autopsy protocols of 1,889 consecutive autopsies in the Albany, N. Y. region in 1951 and 1952, found a wide range of agreement between autopsy diagnoses and cause of death as listed on the death certificate. Agreement varied from 93.8 per cent for tuberculosis to no agreement for rheumatic fever, senility and ill-defined causes of death. The heart diseases included in the James et al. study were chronic rheumatic heart disease with a 73.2 per cent agreement; arteriosclerotic heart disease with 72.8 per cent; chronic endocarditis 21.7 per cent; hypertensive heart disease with 17.1 per cent agreement and other forms of heart disease with no agreement.

Hensman and Lipworth (1966) studied the "Accuracy of certification of Causes of Death" during a six month period of 1959 in England and Wales. In this study both the hospital clinicians and the pathologists performing the autopsies were requested to complete a dummy certificate of the cause of death for each case separately. In general, the agreement in this study was only 45.3 per cent between the dummy certificate and cause of death on the pathologists death certificate. Among the diseases included were lung cancer and peptic ulcer which were diagnosed less frequently by the clinicians while arteriosclerotic heart disease, bronchitis and pneumonia showed "good agreement." A tendency on the part of clinicians to overdiagnose cerebrovascular disease was noted.

The cause of death on death certificate has been compared with questionnaires sent to the physicians who had signed death certificates. Each physician was asked to describe his diagnostic method, to state

the certainty of his diagnosis and to revise the medical certification if his opinion on diagnosis had changed since signing the death certificate. Moriyama et al. (1958), in such a study in Pennsylvania during three months of 1956, found that for all causes, 79 per cent of the medical certification appeared to be the most probable diagnosis; another diagnosis appeared equally probable in 13 per cent, and in 5 per cent, another diagnosis was preferred. The per cent of correct diagnoses recorded in this study were: for rheumatic fever and rheumatic heart disease, 83 per cent; arteriosclerotic heart disease 79 per cent; other heart disease except hypertension, 67 per cent and hypertensive diseases, 76 per cent.

It is apparent that for some causes of death there are considerable inaccuracies in the medical statements, because of misdiagnosis, misregistration or miscoding.

Review of Literature on Sudden Death (SD)

A major problem in all studies dealing with evaluation of cause of death statement is the definition and classification of sudden death. It therefore appears appropriate to devote a section of this chapter to this topic.

The definition of "Sudden Death" has varied from instantaneous death, that is death occurring within a few minutes, to all deaths occurring within three days of the onset of clinical manifestations of the disease. The American Heart Association (1960) reported that at the present time there is insufficient quantitative evidence to justify the use of sudden death as an index of the frequency of IHD, except in the case on instantaneous death. The American Heart Association (1960) also stated that the refinement of the definition of sudden death should be

made in certification of cause of death. Sudden death should include those cases in which there has been an eye witness account and in which the unexplained or unexpected sudden death has occurred within a matter of minutes is desirable. This group of cases should be clearly separated from those in which the fatal event took a longer time, and from those unobserved deaths in which the body was found at an unknown interval of time after death.

Hurst and Logue (1970) stated that SD is probably best defined as natural death, occurring instantaneously or up to 1 hour after the onset of symptoms, in a patient who may or may not have known of pre-existing disease but for whom the time and mode of death came unexpectedly. Thus, three words that should stand out in the definition of SD are: 1) natural; 2) unexpected, and 3) rapid.

Spain et al. (1960) in reviewing the causes of sudden death, found that a witnessed fatal episode lasting less than an hour was due to coronary atherosclerotic in over 90 per cent of cases. If sudden death is to be used as an index of ischemic heart disease, the WHO Expert Committee (1959) recommended that except in special studies, this term be used in the sense of instantaneous death.

In fact, the majority of IHD SD is not associated with pathological evidence of acute myocardial infarction. Most other cardiovascular diseases may cause SD on occasion: aortic stenosis, aortic insufficiency, coarctation of the aorta, dissecting aneurysm of the aorta, primary myocardial disease, primary pulmonary hypertension, myocarditis and all arrhythmias can be a cause of SD. Pregnant women with pulmonary hypertension are estimated to have a 53 per cent risk of SD, usually at delivery or in the puerperium (Jones and Hawitt, 1965; Hurst and Logue,

1970). Pulmonary embolism has been recognized more frequently as a cause of SD in recent years than in the past. Among diseases of the central nervous system that may cause SD, cerebral and subarachnoid hemorrhage stand out; cerebrovascular thrombosis and embolism rarely appear to be the cause of SD. Miscellaneous gastro-intestinal and genito-urinary disease occasionally are implicated (Kuller, 1966; Kuller et al., 1967; Hurst and Logue, 1970; Burch and Depasquale, 1965).

Though the relative frequency of the various causes of SD in the adult group is influenced by the source of the data studied, one fact stands out. Regardless of the criteria used and the population studied, the most common cause of sudden, unexpected, natural death in adults, is cardiovascular disease, and among these deaths, IHD is the specific entity most frequently identified (Kuller, 1966; Kuller et al., 1967; Burch and Depasquale, 1965; Pruitt, 1964). When SD is defined as instantaneous death or death within an hour of the onset of symptoms, 80 to 90 per cent of such deaths are due to cardiovascular disease. When the more liberal definition of death within 24 hours after the onset of symptoms is used, the relative proportion of deaths due to cardiovascular disease decreases to about 50 to 60 per cent (Hurst and Logue, 1970).

An overwhelming majority (about 90 per cent) of the sudden cardiovascular deaths in men is attributable to IHD. The proportion is somewhat lower in women (Hurst and Logue, 1970). In a study of 1,348 SD cases due to IHD, Meyerburg and Davis (1964) showed that only 26 per cent had known coronary disease and 33 per cent had undiagnosed symptoms of coronary disease. In the remaining 41 per cent, SD was the first and only clinically recognizable manifestation of the disease.

The true incidence of sudden, unexpected, natural death remains

unknown. The results of most studies are difficult to comapare, especially in regard to the specific cause of SD. It can readily be understood that incidence statistics from a medical examiner's office will differ from those in a death certificate study or a prospective community study. An estimate of the percentage of all natural deaths which are sudden and unexpected would be in the range of 15 to 30 per cent (Kuller, 1966; Kuller et al., 1967; Burch and Depasquale, 1965). There are two peaks in the incidence curve for sudden natural deaths: 1) between birth and 6 months of age; 2) between the ages of 35 and 70 years. In both groups, there is a marked preponderance of males (Burch and Depasquale, 1965; Valses-Dapena, 1967).

Hurst and Logue (1970) reported the classical clinical picture of SD to be one in which the patient is perfectly well one moment and becomes agonal an instant later. Resuscitative efforts are feasible during the first 4 to 6 minutes after the onset of clinical death. When cellular death has ensued, resuscitation is not possible and irreversible biological death has occurred.

Hurst and Logue (1970) reported that despite the great medical advances of this century, the very nature of SD has precluded any major advances in our ability to institute preventive measures. A more complete understanding of pathophysiology of SD, it is to be hoped, lies in the future.

CHAPTER III

METHODS AND MATERIALS

This study has been divided into two parts. One dealing with an estimate of the reliability of the cause of death statement on the death certificates of people said to have died from three major forms of heart disease (Ischemic Heart Disease in 1970; Hypertensive Heart Disease and Chronic Rheumatic Heart Disease in 1969-1970) in Oklahoma City. The other part dealing with the descriptive epidemiology of deaths from all forms of heart disease in Oklahoma County for the period January 1, 1966 and December 30, 1970.

The present study differs from previous investigations in several respects. First, it is focused upon the reliability of cause of death statements of the three most frequent types of heart disease. Second, it is based on a random sample of deaths attributed to heart disease. This eliminates the bias inherent in autopsy studies, or studies restricted to hospital patients. Third, it utilizes several sources of information: medical records, autopsy protocols, mailed questionnaires and interviews. Fourth, it includes a descriptive epidemiological analysis of all death certificates which listed a heart disease as the cause of death. Thus it is based on somewhat more comprehensive information than most studies.

Finally, the author himself has rated the reliability of the

cause of death statement on all certificates studied, by reference to the standard criteria and the International Standard Classification of Disease. Since all the data have been evaluated by the same investigator, there should be more uniformity and consistency in the ratings. This method has not been employed in any other study.

Diagnostic Criteria and Classification of Heart Disease

In order to sort, recognize and classify heart disease, a brief review of diagnostic criteria of three forms of heart disease (Ischemic Heart Disease, Hypertensive Heart Disease and Chronic Rheumatic Heart Disease) and International Standard Classification of Disease is necessary.

A review of the literature and personal contact with cardiologists of the Oklahoma University Health Sciences Center; Oklahoma Heart Association and American Heart Association revealed only a paucity of references regarding the quality of heart disease diagnosis.

Ischemic Heart Disease (IHD)

This is a disorder of lipid metabolism thought to be responsible for the localized subintimal accumulation of fatty and fibrous tissues which progressively obstructs the epicardial portion of the coronary arteries and their main brances (Brainerd et al., 1969; Hurst and Logue, 1970; Friedberg, 1966).

The term "ischemic heart disease" was defined by the WHO Expert Committee on Atherosclerosis and IHD (1957) as "the cardiac disability, acute and chronic, arising from reduction or arrest of blood supply to the myocardium in association with disease processes in the coronary arterial system." Myocardial infarction occurs due to obstruction of the

coronary circulation which causes necrosis of a macroscopic, circumscribed area of the myocardium. Such an area will, if death does not ensue, undergo fibrosis (American Heart Association - National Health Institute, 1960; Hurst and Logue, 1970).

According to the American Heart Association - National Heart Institute (1960); The Criteria Committee of the New York Heart Association (1964); Friedberg (1966); Hurst and Logue (1970), the rating of quality of diagnosis of IHD may be established into definite, possible, doubtful and wrong diagnoses.

A Definite Reliable Diagnosis.

1. History - A clear history of typical chest pain or discomfort which usually occurred at rest, located and radiating as in anginal syndrome, frequently associated with vasomotor collapse and often requiring prolonged bed rest. The duration of pain in myocardial infarction is longer than anginal pain (duration of pain in angina pectoris is longer than 30 seconds, but rarely as long as 10 minutes).
2. Electrocardiogram (ECG) - Serial ECG's taken during the acute phase of myocardial infarction are usually conclusive evidence of the lesion. A typical ECG finding of IHD is strongly suggestive.
3. The laboratory findings mainly include the abnormalities in serum activity of enzymes such as serum glutamic oxalacetic transaminase (SGOT), lactic dehydrogenase (LDH), creatine phosphokinase (CPK) and serum alpha-hydroxybutyrate dehydrogenase (SHBD).

If two of the above criteria were present the diagnosis was

classified as "definite" diagnosis.

4. Autopsy diagnosis of IHD was classified as in the "definite" category of diagnosis.
5. In some cases if cinearteriography and vector cardiogram had been done, these also confirmed the diagnosis.

Possible Diagnosis.

1. History - The history was not as clear cut as in definite IHD but included pain or discomfort similar in location to that of anginal syndrome.
2. Electrocardiogram (ECG) - The ECG was suggestive but was not typical of definite IHD. If ECG evidence was not existent, the chest pain should be typical and enzyme study be to some degree suggestive of IHD.

Doubtful Diagnosis.

1. Doubtful chest pain or discomfort.
2. The history of chest pain was obtained by a physician from the deceased's relatives or friend after the patient expired.
3. The ECG study either had not been done or it was not suggestive of IHD.
4. The serum enzyme activity was not suggestive of IHD.
5. Merely the impression of a physician that the person died from IHD without any support of recorded clinical, laboratory or ECG evidence of IHD, is also included in the category of doubtful diagnosis.

Wrong Diagnoses. When patient died of some other disease and by mistake was certified or coded under IHD, it was classified as a wrong diagnosis.

Although myocardial infarction has become increasingly well recognized, there continues to appear at necropsy, myocardial infarction unrecognized clinically (Johnson et al., 1958; Wood, 1968). Johnson et al. (1958) performed 1,267 necropsies during the years 1953 and 1954. They found 143 cases of either acute or healed myocardial infarction or both. About 50 per cent of these 143 cases had no clinical diagnosis or recorded suspicion of previous myocardial infarction. The unrecognized or silent myocardial infarctions without any sign or pain usually cannot be diagnosed unless the autopsy is performed (Johnson et al., 1958).

Hypertensive Heart Disease (HHD)

The Criteria Committee of the New York Heart Association (1964) and Friedberg (1966) stated that hypertension which has not demonstrably affected the heart is called "Hypertensive Vascular Disease." When left ventricular hypertrophy, heart failure, or coronary artery disease is present, "Hypertensive Cardiovascular Disease" or "Hypertensive Heart Disease" is the appropriate term.

The criteria for the diagnosis of hypertension are arbitrary because the arterial pressure rises with age and varies from one occasion of measurement to another (Moriyama et al., 1971; Brainerd et al., 1969). Hurst and Logue (1971) stated that there are many arguments and suggestions for the clear cut limit of systolic and diastolic normotension and hypertension. The following appears to be a satisfactory definition of the hypertensive process according to The American Heart Association - National Heart Institute (1960):

> Normotension. Systolic blood pressure below 140 mm Hg and diastolic blood pressure below 90 mm Hg.

Hypertension. Systolic blood pressure of 160 mm Hg or over and diastolic blood pressure of 95 mm Hg or over, i.e. either one or both at or above the specified levels.

Systolic Hypertension. Systolic blood pressure 160 mm Hg or over and diastolic blood pressure under 90 mm Hg.

Diastolic Hypertension. Systolic blood pressure under 140 mm Hg and diastolic blood pressure 95 mm Hg or more.

Borderline Hypertension. This is the residual category, i.e. the systolic blood pressure is below 160 mm Hg and the diastolic blood pressure is below 95 mm Hg, but they are not simultaneously below both 140 mm Hg systolic and 90 mm Hg diastolic.

According to the American Heart Association - National Heart Institute (1960) and the Criteria Committee of the New York Heart Association (1964); Friedberg (1966); Hurst and Logue (1970), the rating of quality of diagnosis of HHD may be established into definite, possible, doubtful and wrong diagnoses.

Definite Reliable Diagnosis.

1. A history of persistant or transient hypertension.
2. Left ventricular hypertrophy (LVH). The confirmation of LVH or cardiac involvemenent by x-ray and/or ECG.

If the above two criteria were present, the diagnosis was classified as definite diagnosis.

3. Keith-Wagener (KW) retinal changes if retinoscopy had been done and recorded was also helpful in the confirmation of the diagnosis.
4. Autopsy diagnosis alone with history of hypertension

was considered as a definite diagnosis.

Possible Diagnosis. A history of hypertension with physician impression of LVH or cardiac involvement.

Doubtful Diagnosis. No reliable documentation of hypertension, LVH or cardiac involvement.

Wrong Diagnosis. This category consisted of those patients who died from some other disease and who by mistake were certified or coded under HHD.

Chronic Rheumatic Heart Disease (CRHD)

Hurst and Logue (1970) stated that CRHD results from single or repeated attacks of rheumatic fever which produce rigidity and deformity of the cusps, fusion of the commisures, or shortening and fusion of the chordae tendinae. Wood (1968); Friedberg (1966); Markowitz and Gordis (1972) reported that rheumatic heart disease occurs in about a third of the patients who have acute rheumatic fever. It is more common in those who have obvious carditis (Walker, 1970; Markowitz et al., 1965).

According to the Criteria Committee of the New York Heart Association (1964); Hall (1961 and 1970); Hurst and Logue (1970); and Markowitz and Gordis (1972), the rating of quality of diagnosis of CRHD may be established into definite, possible, doubtful and wrong diagnoses.

Definite Reliable Diagnosis. This category consists of those criteria suggested by Hall (1961 and 1970); Wallach et al. (1962) and satisfying the criteria of the New York Heart Association as they are listed in Appendix A.

The presence of a definite history of Acute Rheumatic Fever (ARF) tends to confirm the diagnosis, however, the probable history of

ARF or uncertain history of ARF does not change the definite diagnosis of RHD, because there are cases of definite RHD in whom the past history of ARF is not obvious.

The autopsy diagnosis alone was considered as a definite diagnosis of CRHD.

Possible Diagnosis. This category consisted of those patients in which the diagnosis of CRHD was probable but not confirmed because of doubtful auscultatory findings without roentgenographic or electrocardiographic confirmation. The impression of the physician in regard to a murmur but without x-ray, ECG or special studies was categorized in this group.

Doubtful Diagnosis. This category consisted of those cases in which the disease was less probable, and the history of rheumatic fever and RHD were not present. Cases were placed in this group if the auscultatory findings were not suggestive, especially if the patient had coexistent hypertension, thyrotoxicosis, severe anemia or suspected congenital heart disease.

Wrong Diagnosis. This category consisted of those patients who died from some other diseases and by mistake were certified or coded under CRHD.

Sudden Death

The review of the literature in Chapter II indicated that criteria for recording Dead on Arrival (DOA), Sudden Death (SD), and Victim Found Dead (VFD) were not uniform. There was some uncertainty as to the definition of these terms in reference to the time interval from onset of the disease to the time that the victim expired. For these

reasons, the DOA, SD, and VFD were combined in a single category of Sudden Death in the present study.

The diagnosis of SD was considered reliable if the diagnosis of of SD was confirmed by: autopsy, clinical information or the information obtained from the witness who attended the victim. Information concerning the time interval from the onset to death was considered to be critical. In the absence of such information the diagnosis of SD will be considred unreliable.

International Standard Classification of Heart Disease

Ischemic Heart Disease included the rubrics (410-414) in the Eighth and (420-422) in the Seventh Revisions of International Classification of Disease (ICD), (USPHS, International Standard Classification of Disease, 1968).

Hypertensive Heart Disease included some of the rubrics (401-404) in the Eighth and (440-443) in the Seventh Revisions of ICD.

Chronic Rheumatic Heart Disease included rubrics (393-398) in the Eighth and (410-416) in the Seventh Revisions of ICD.

Congenital Heart Disease included some of the (746-747) rubrics in the Eighth and (754) in the Seventh Revisions of ICD.

Other Forms of Heart Disease included rubrics (420-429) in the Eighth and (430-434) in the Seventh Revisions of ICD.

Further explanations of these rubrics of the Seventh and Eighth Revisions of the ICD are given in Appendix A.

Part I - The Reliability Study

Study Population

Subjects for the reliablity study were residents of Oklahoma

City who died in Oklahoma City from IHD in 1970 and from HHD and CRHD in 1969 and 1970.

Due to the difficulty of follow-up, non-residents of Oklahoma City who died elsewhere were excluded from this part of the study. The cases of cardiovascular disease without mention of ischemic heart disease, hypertensive disease without heart involvement, and valvular heart disease not specified as rheumatic, were also excluded from this part of the study, because of the uncertainty of the specific cause of death.

Sample Size

A random sample of 100 cases (or 10.1 per cent) from 990 IHD deaths in 1970 which met the criteria previously described were drawn as follows:

1. A reprint list of 1,402 deaths from all forms of IHD reported among residents and non-residents of Oklahoma County who died in Oklahoma County was obtained from the Division of Vital Statistics of the Oklahoma State Department of Health for 1970.

2. Among the 1,402 deaths, 990 cases met the criteria described for inclusion in the study.

3. Each name and identification characteristics were listed by serial number.

4. With the aid of Table of Random Numbers (The Rand Corporation, 1955), 100 cases were drawn from the 990 cases.

In 1970 there were only 14 deaths from HHD and 9 deaths from CRHD which met the stated criteria. Since these numbers were small, it was decided to include total deaths from HHD and CRHD for two years, 1969 and 1970. Using this method, a sample of 59 cases was obtained, 41

deaths from HHD and 18 deaths from CRHD. These 59 cases were added to the 100 who died from IHD, yielding a total sample size of 159 cases.

Procedure for Compiling the Required Data

Identification, social history and clinical information on the deceased persons were obtained from the death certificates, hospitals, nursing and convalescent homes, and physician's offices.

The original death certificates of the 159 cases were obtained from the Division of Vital Statistics of the Oklahoma State Department of Health. From these death certificates, full identification, social history, place of death and medical information for each of the deceased person were obtained. The place of death statements included hospitals, nursing and convalescent homes, their own or other's homes, a restaurant and a car. From these places of death, from the physicians who signed the death certificates and from the Oklahoma State Medical Examiner's Office, the social and clinical information contained on Forms I (Appendix A), II (Appendix A), III (Appendix A), IV (Appendix A), and V (Appendix A) were obtained in 145 cases by personal visits, in 11 cases by marked questionnaire forms and in 3 cases by telephone. Form I with a covering letter was sent to physicians. This form includes the following questions: Is the above cause of death the same that you found? For how long did you treat the deceased? Was the death sudden? Were you attending the victim at the time of expiration? If your source of information is another physician, please state his name and address (Appendix A). Form II included information about the identification: address; marital status; risk factors; past personal and family history of the deceased (Appendix A). Form III, IV, and V include diagnostic

information of IHD, HHD and CRHD respectively (Appendix A).

The Classification of Accuracy of Diagnoses of Cause of Death on Death Certificate

According to the criteria described, the statement of cause of death on the death certificate was classified into one of the five categories:

1. Definite Reliable Diagnosis.
2. Possible Reliable Diagnosis.
3. Doubtful Diagnosis.
4. Wrong Diagnosis.
5. Sudden Death (SD), Dead on Arrival (DOA), and Victim Found Dead (VFD).

A summary of diagnostic criteria for each of the above categories is shown in Table I, Appendix A.

Description of the Study Group

Of the 159 cases in the sample, clinical information could not be obtained for 9 cases. The characteristics of the 9 missing cases are shown in Table II, Appendix A. Of these 9 deaths, seven were attributed to IHD, one to HHD and one to CRHD. There were several reasons that information was not available: one physician refused information; one nursing home was closed; another nursing home refused to give information; another nursing home could not find the patient's chart; two physicians could not be located and one hospital could not locate a chart. Because of the absence of the required necessary data on these nine cases, they were omitted from the study. (See Table II, Appendix A for characteristics of the nine cases).

Of the 150 remaining in the sample, 93 were IHD, 40 HHD, and 17 CRHD deaths (thus information was obtained for: 93 per cent of IHD deaths in the original sample; for 98 per cent of HHD and 95 per cent of CRHD.

Throughout the analysis the three categories of heart disease (IHD, HHD and CRHD) and the five categories of reliability of diagnosis (definite, possible, doubtful, wrong and sudden death) will be treated separately.

When the author rated the diagnosis of cause of death on the death certificate as definite or possible, the author was in agreement with the diagnosis (and according to the stated criteria, it was a reliable diagnosis). When the death certificate diagnosis was rated as doubtful or wrong, the author and the death certificate were considered to be in disagreement (and according to the stated criteria, it was an unreliable diagnosis).

Part II - Descriptive Epidemiology

It has been stated that the descriptive epidemiological analysis of mortality data of heart disease serves as the background information to the main and specific objective of this study.

Study Population and Procedure for Compiling the Required Data

The descriptive epidemiological study included residents of Oklahoma County who died from heart disease between January 1, 1966 through December 30, 1970. The data were obtained from death certificate records of the Division of Vital Statistics of the Oklahoma State Department of Health for the five-year period. In reference to Inter-

national Standard Classification of Disease (Appendix A), the heart disease was classified into five categories (IHD, HHD; CRHD; Congenital Heart Disease and Other Forms of Heart Disease). For each death, information was collected as to: cause of death, race, sex, age, place of death, date of death, attendant, residence, and death certificate number.

CHAPTER IV

RESULTS

In accordance with objectives, methods and materials, the results of this study are divided into Part I and Part II.

Part I - Reliability Study

In accordance with the principal objective of this study, Part I results include the analysis of data which estimates the degree of reliability of diagnosis of "cause of death" from the three categories of heart disease (IHD, HHD and CRHD) on the death certificates of residents of Oklahoma City.

The criteria used for rating the quality of diagnostic information differed for the specific forms of heart disease. The criteria for each of the five categories (Definite, Possible, Doubtful, Wrong diagnoses and SD) have been discussed in Chapter III. A brief summary of the criteria is given in Table I of Appendix A.

Comparison of Diagnostic Rating in This Study with Cause of Death on the Death Certificate

Since the major concern in this study is an estimation of the reliability of heart disease mortality data, all analyses are presented in terms of the underlying cause as stated on the original death certificate. All the 150 cases were therefore judged by the predetermined

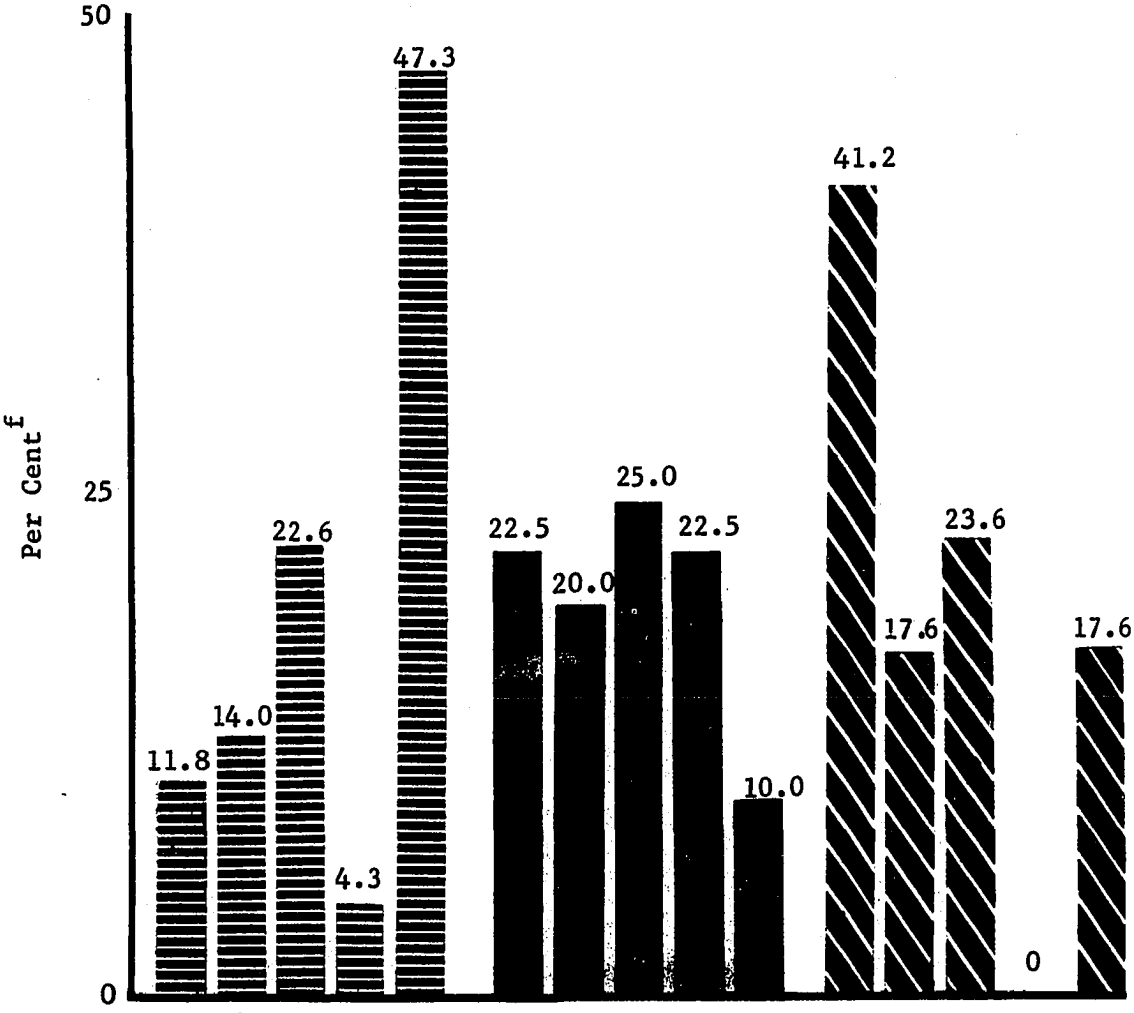
clinical criteria established by the author and each case assigned into one of the five categories (definite, possible, doubtful, wrong and SD) for quality of diagnosis. The result of the ratings into the five categories is presented in Figure 1. Figure 1 shows that the highest proportion (47.3 per cent) of IHD was SD and the smallest (4.3 per cent) was wrong diagnosis. The highest proportion (41.2 per cent) of CRHD was "definite" diagnosis and there were no wrong diagnoses among CRHD cases.

Specific Cause of Death

Table 1 shows the specific cause of death from IHD on the death certificates by their reliability of diagnoses. As would be expected, there were many more sudden deaths in the acute myocardial infarction category than in the chronic IHD category.

Table 1 also shows that in the acute myocardial infarction, the largest category was SD (62.5 per cent) and the second largest was agreement (21.9 per cent) and smallest was disagreement diagnosis (15.6 per cent). On the other hand, in the chronic IHD, the agreement and disagreement diagnoses were almost equally distributed (25.4 vs. 26.9 per cent) and the largest category was SD (47.3 per cent.

Table 2 shows the specific cause of death from all HHD by its quality of diagnosis in the two years of the study, 1969-1970. Of the total of 40 HHD deaths 24 (60.0 per cent) were HHD and the other 16 (40.0 per cent) were mixed hypertensive heart and renal disease (HHRD). None of the 4 SD were reported from HHRD. The agreement between death certificate diagnoses and the author's criteria was greater than the disagreement for the diagnosis of HHD (50.0 vs. 33.3 per cent) and SD was 16.7 per cent. The overall reliability study of total HHD indicated



[f]Per cent of the total of each form of heart disease.

Fig. 1. Per cent distribution, by rating, of the three forms of heart disease diagnosis on the death certificate.

TABLE 1

THE RELIABILITY OF ISCHEMIC HEART DISEASE (IHD) DIAGNOSIS ON DEATH CERTIFICATE BY SPECIFIC CAUSE OF DEATH, OKLAHOMA CITY SAMPLE, 1970

Reliability of Diagnosis	Acute Myocardial Infarction	Chronic IHD	Total
Definite	8 (12.5)[a]	3 (10.4)	11 (11.4)
Possible	6 (9.4)	7 (24.1)	13 (14.0)
Doubtful	10 (15.6)	11 (37.9)	21 (22.6)
Wrong	0	4 (13.8)	4 (4.3)
Sudden Death	40 (62.5)	4 (13.8)	44 (47.3)
Total	64 (100.0)	29 (100.0)	93 (100.0)

[a]Numbers in parentheses are per cent of total of each column.

TABLE 2

THE RELIABILITY OF HYPERTENSIVE HEART DISEASE (HHD) DIAGNOSIS ON DEATH CERTIFICATE BY SPECIFIC CAUSE OF DEATH OKLAHOMA CITY, 1969-1970

Reliability of Diagnosis	HHD	HH & RD[a]	Total
Definite	6 (25.0)[b]	3 (18.8)	9 (22.5)
Possible	6 (25.5)	2 (12.5)	8 (20.0)
Doubtful	6 (25.0)	4 (25.0)	10 (25.0)
Wrong	2 (8.3)	7 (43.7)	9 (22.5)
Sudden Death	4 (16.7)	0	4 (10.0)
Total	24 (100.0)	16 (100.0)	40 (100.0)

[a]Hypertensive heart and renal disease.
[b]Numbers in parentheses are per cent of total of each column.

slightly more disagreement than agreement in this study (47.5 vs. 42.5 per cent) and 10 per cent SD (Table 2).

The overall reliability analysis of death from CRHD on the death certificate indicated that there was more reliable diagnoses than unreliable diagnosis (58.8 vs. 23.6 per cent) and the SD was 17.6 per cent (Table 3). The number of deaths from CRHD was too small to justify further analysis by specific cause of death.

Major Criteria

Table 4 and Table 5 show the reliability of IHD diagnosis on the death certificate by history and major clinical criteria. The pattern of distribution of these characteristics indicates that a higher percentage of positive history and typical signs and symptoms were recorded for the definite and possible category than others. Autopsy diagnosis of IHD was made in 5 deaths, (5.4 per cent) of the total 93 IHD deaths. All the autopsy diagnoses were considered as definite diagnoses; these constituted 20.8 per cent of the total of 24 definite and possible diagnoses.

Table 6 shows that a history of hypertension was recorded in the majority (82.4 per cent) of the definite and possible diagnoses of HHD. There were no autopsies nor ECG evidence of HHD in the doubtful and wrong categories. Autopsies were performed in 10 per cent (4 deaths) of the total of 40 HHD deaths. All autopsy diagnoses were considered definite; which constituted 23.4 per cent of the total of 17 definite and possible diagnosis in this study.

Table 7 on CRHD shows that in the majority (80.0 per cent) of cases of definite and possible diagnoses, a heart murmur was recorded.

TABLE 3

THE RELIABILITY OF CHRONIC RHEUMATIC HEART DISEASE DIAGNOSIS ON DEATH CERTIFICATE BY SPECIFIC CAUSE OF DEATH, OKLAHOMA CITY, 1969-1970

Reliability of Diagnosis	Disease of Mitral Valve	Disease of Aortic Valve	Disease of Mitral & Aortic	Other HD Specified as Rheumatic	Total
Definite	3 (100.0)[a]	1 (25.0)	0	3 (33.4)	7 (41.2)
Possible	0	1 (25.0)	0	2 (22.2)	3 (17.6)
Doubtful	0	2 (50.0)	0	2 (22.2)	4 (23.6)
Wrong	0	0	0	0	0
Sudden Death	0	0	1 (100.0)	2 (22.2)	2 (17.6)
Total	3 (100.0)	4 (100.0)	1 (100.0)	9 (100.0)	17 (100.0)

[a]Numbers in parentheses are percent of total of each column.

TABLE 4

THE RELIABILITY OF ISCHEMIC HEART DISEASE (IHD) DIAGNOSIS ON DEATH CERTIFICATE BY THE RECORDED PERSONAL AND FAMILY HISTORY, OKLAHOMA CITY SAMPLE, 1970

History	Per cent of Deaths with History Recorded			
	Definite & Possible	Doubtful & Wrong	Sudden Death	Total
Personal				
IHD	41.7	8.0	9.1	17.2
Diabetes	20.8	4.0	6.8	9.7
Hypertension	8.3	4.0	9.1	7.5
Overweight	4.2	8.0	0	3.2
Family				
IHD	4.2	4.0	0	2.2
Hypertension	4.2	0	0	1.1

TABLE 5

THE RELIABILITY OF ISCHEMIC HEART DISEASE (IHD) DIAGNOSIS ON DEATH CERTIFICATE BY RECORDED MAJOR CLINICAL CRITERIA, OKLAHOMA CITY SAMPLE, 1970

Sign & Symptom	Per cent of Deaths with Signs and Symptoms Present		
	Definite & Possible	Doubtful & Wrong	Total
ECG - IHD	75.0	0	36.7
Chest Pain	58.3	12.0	34.7
Autopsy - IHD	20.8	0	10.2
Laboratory			
SGOT	20.8	8.0	14.3
LDH	16.7	0	8.2
Uric Acid	12.5	8.0	10.2
Cholesterol	0	12.0	6.1

TABLE 6

THE RELIABILITY OF HYPERTENSIVE HEART DISEASE (HHD) DIAGNOSIS ON DEATH CERTIFICATE BY MAJOR CLINICAL CRITERIA, OKLAHOMA CITY, 1969 and 1970

Sign & Symptom	Per cent of Signs and Symptoms Present		
	Definite & Possible	Doubtful & Wrong	Total
Hypertension	82.4	5.3	41.7
X-ray - Cardiomegaly	58.8	5.3	30.6
ECG - LVH[a]	35.3	0	16.7
Autopsy - HHD	23.4	0	11.1

[a]Left Ventricular Hypertrophy.

TABLE 7

THE RELIABILITY OF CHRONIC RHEUMATIC HEART DISEASE (CRHD) DIAGNOSIS ON DEATH CERTIFICATE BY MAJOR CLINICAL CRITERIA, OKLAHOMA CITY, 1969 and 1970

Sign & Symptom	Definite & Possible	Doubtful & Wrong	Total
Murmur	80.0	0	57.1
X-ray - RHD[a] and/or Cardiomegaly	80.0	75.0	78.6
Autopsy - RHD	50.0	0	35.7
History of RF[a] and/or RHD	30.0	0	21.4
Catheterization - RHD	20.0	0	14.3
ECG - RHD and/or Cardiomegaly	10.0	50.0	21.4
Laboratory			
ESR	10.0	0	7.1
ASO	0	25.0	7.1

[a]Rheumatic fever, rheumatic heart disease.

Autopsy was performed in 35.7 per cent (5 deaths) of the total 14 CRHD deaths (which was 50 per cent of the "definite and possible" diagnoses of CRHD).

Sudden Death (SD)

SD included DOA (dead on arrival); VFD (victim found dead) and unexpected (or sudden death). DOA and unexpected death were usually attended either by medical or non-medical personnel. VFD (victim found dead) were unwitnessed and unattended deaths.

Table 8 shows the distribution of IHD sudden deaths by the time interval from onset of the disease to death. The majority (26 deaths or 59.1 per cent) of IHD sudden deaths were DOA. The records of the "sudden deaths" showed that 4 (9.1 per cent) of the total of 44 IHD sudden deaths died within one hour from the onset. The majority (72.7 per cent) died with no record of the time interval from the onset to the time of death. Of the 44 IHD sudden deaths, only on one (2.3 per cent) was an autopsy performed, which indicated advanced tri-vessel atherosclerosis. This was the only autopsy performed among 51 sudden deaths from all categories.

There were 4 (10.0 per cent) sudden deaths among the total of 40 HHD deaths. Three of the 4 were DOA; (one died within 12 hours, but the time interval between onset and death was not recorded for the other two). The fourth HHD sudden death was VFD, in which the onset-death time interval was unknown.

There were 3 (17.6 per cent) sudden deaths among the total of 17 CRHD deaths. All 3 sudden deaths were DOAs. One of them died within 12 hours but the other two onset-death time intervals were unrecorded.

TABLE 8

THE DISTRIBUTION OF IHD SUDDEN DEATH BY INTERVAL FROM ONSET TO DEATH
OKLAHOMA CITY SAMPLE, 1970

Sudden Death	Interval from Onset to Death			Total	%
	1 hr.	12 hrs.	Unrecorded		
DOA[a]: Expired:					
1. On the way to hospital	0	0	1	1	2.3
2. In hospital	1	3	1	5	11.3
3. Other place	0	0	1	1	2.3
4. Unrecorded	0	0	19	19	43.2
Victim Found Dead:					
1. At home	0	3	4	7	15.9
2. Other place	0	0	1[b]	1	2.3
Unexpected Death:					
1. At home	3	2	4	9	20.4
2. In hospital	0	0	1	1	2.3
Total	4	8	32	44	100.0
Per cent	9.1	18.2	72.7	100.0	

[a]Dead on Arrival.
[b]Autopsy showed advanced trivessel atheriosclerosis.

Reliability by Sex

Table 9 presents the diagnostic ratings of the 93 IHD deaths by sex. Of the 49 male deaths, the majority (57.2 per cent) were SD. This was a substantially higher proportion than for females (36.4 per cent). Among females, a considerable proportion, 40.9 per cent were doubtful or wrong diagnoses; whereas only 14.3 per cent (7 deaths) of the male deaths were rated as doubtful or wrong.

Table 10 presents the diagnostic rating of the 40 HHD deaths by sex. Of the 27 male deaths, the highest proportion (29.6 per cent) was in the "definite" diagnosis category, which was remarkably higher than the female proportion of 7.7 per cent. Among females, a majority (61.6 per cent of the total 13 female deaths) was in the doubtful and wrong diagnosis category; which was higher than the 40.8 per cent of the total of 27 male deaths.

Table 11 presents the diagnostic rating of the 17 CRHD deaths by sex. Of the 6 female deaths a majority (66.6 per cent) were "definite" diagnoses which was higher than the male proportion of 27.2 per cent. All the 4 "doubtful" diagnoses were in males. There were no wrong diagnoses for CRHD.

Reliability by Race and Marital Status

Of all the IHD deaths in Table 12, 83 (89.2 per cent) were Caucasian and 10 (10.8 per cent) were Negro. Of the 10 Negroes, the majority (60.0 per cent) were SD, as compared with 45.8 per cent for Caucasians.

Among Caucasians, 27.7 per cent were definite and possible diagnoses; only 10.0 per cent among Negroes.

TABLE 9

THE RELIABILITY OF ISCHEMIC HEART DISEASE DIAGNOSIS ON DEATH CERTIFICATES BY SEX, OKLAHOMA CITY SAMPLE, 1970

Reliability of Diagnosis	Male		Female		Total	
	No.	%	No.	%	No.	%
Definite	8	16.3	3	6.8	11	11.8
Possible	6	12.2	7	15.9	13	14.0
Doubtful	7	14.3	14	31.8	21	22.6
Wrong	0	0	4	9.1	4	4.3
Sudden Death	28	57.2	16	36.4	44	47.3
Total	49	100.0	44	100.0	93	100.0
Per cent	52.7		47.3		100.0	

TABLE 10

THE RELIABILITY OF HYPERTENSIVE HEART DISEASE DIAGNOSIS ON DEATH CERTIFICATES BY SEX, OKLAHOMA CITY, 1969 and 1970

Reliability of Diagnosis	Male		Female		Total	
	No.	%	No.	%	No.	%
Definite	8	29.6	1	7.7	9	22.5
Possible	5	18.5	3	23.0	8	20.0
Doubtful	6	22.3	4	30.8	10	25.0
Wrong	5	18.5	4	30.8	9	22.5
Sudden Death	3	11.1	1	7.7	4	10.0
Total	27	100.0	13	100.0	40	100.0
Per cent		65.0		35.0		100.0

TABLE 11

THE RELIABILITY OF CHRONIC RHEUMATIC HEART DISEASE DIAGNOSIS ON DEATH CERTIFICATES BY SEX, OKLAHOMA CITY, 1969 and 1970

Reliability of Diagnosis	Male		Female		Total	
	No.	%	No.	%	No.	%
Definite	3	27.2	4	66.6	7	41.2
Possible	2	18.2	1	16.7	3	17.6
Doubtful	4	36.4	0	0	4	23.6
Wrong	0	0	0	0	0	0
Sudden Death	2	18.2	1	16.7	3	17.6
Total	11	100.0	6	100.0	17	100.0
Per cent	64.7		35.3		100.0	

TABLE 12

THE RELIABILITY OF ISCHEMIC HEART DISEASE DIAGNOSIS ON DEATH CERTIFICATES BY RACE[a], OKLAHOMA CITY SAMPLE, 1970

Reliability of Diagnosis	Caucasian		Negro	
	No.	%	No.	%
Definite	11	13.2	0	0
Possible	12	14.5	1	10.0
Doubtful	19	22.9	2	20.0
Wrong	3	3.6	1	10.0
Sudden Death	38	45.8	6	60.0
Total	83	100.0	10	100.0
Per cent	89.2		10.8	

[a]No deaths among Indians.

Among all those who died of HHD (Table 13) there were 25 (62.5 per cent Caucasians), 15 (37.5 per cent) Negroes. The proportion of definite and possible diagnoses among Negroes was 53.3 per cent.

The race comparison of the reliability of CRHD deaths shows that there were 15 (88.2 per cent) Caucasians, 2 (11.8 per cent) Negroes. The relative frequency of doubtful diagnoses was only 4 (26.7 per cent) among Caucasians and none among Negroes (Table 14).

The reliability of the diagnosis of IHD was greater for Caucasians than for Negroes, whereas the reverse was found to be true for diagnoses of HHD.

The comparison of reliability of the heart disease (IHD, HHD and CRHD) diagnosis (excluding SD) on the death certificate, by sex and marital status is shown in Table 15. The reliability (i.e. definite and possible diagnosis) of the heart disease diagnosis was considerably higher for the married male group as compared to the married female group. The unreliability (doubtful and wrong diagnosis) of the heart disease diagnosis in this study was considerably higher among unmarried females than unmarried males.

The reliability of the diagnosis of specific forms of heart disease (IHD, HHD and CRHD) by Age and Marital Status are shown in Table I-VI, Appendix B, and are not discussed here because of the small number in each cell of the tables.

The Reliability of Heart Diseases Mortality by Place of Death

Table 16 presents the diagnostic ratings of IHD by place of death. Of the 93 IHD deaths, the majority (63.4 per cent) were reported

TABLE 13

THE RELIABILITY OF HYPERTENSIVE HEART DISEASE DIAGNOSIS ON DEATH CERTIFICATES BY RACE[a], OKLAHOMA CITY, 1969 and 1970

Reliability of Diagnosis	Caucasian		Negro	
	No.	%	No.	%
Definite	4	16.0	5	33.3
Possible	5	20.0	3	20.0
Doubtful	7	28.0	3	20.0
Wrong	6	24.0	3	20.0
Sudden Death	3	12.0	1	6.7
Total	25	100.0	15	100.0
Per cent	62.5		37.5	

[a]No deaths among Indians.

TABLE 14

THE RELIABILITY OF CHRONIC RHEUMATIC HEART DISEASE DIAGNOSIS ON DEATH CERTIFICATES BY RACE[a] OKLAHOMA CITY, 1969 and 1970

Reliability of Diagnosis	Caucasian		Negro	
	No.	%	No.	%
Definite	6	40.0	1	50.0
Possible	3	20.0	0	0
Doubtful	4	26.7	0	0
Wrong	0	0	0	0
Sudden Death	2	13.3	1	50.0
Total	15	100.0	2	100.0
Per cent	88.2		11.8	

[a]No deaths among Indians.

TABLE 15

THE RELIABILITY OF CAUSE OF DEATH FROM HEART DISEASE[a] ON THE DEATH CERTIFICATE BY SEX AND MARITAL STATUS[b]

		Diagnosis			
		Definite & Possible	Doubtful & Wrong	Total	%
Male					
Married	No.	27	17	44	81.5
	%	61.4	38.6	100.0	
Unmarried	No.	5	5	10	18.5
	%	50.0	50.0	100.0	
Female					
Married	No.	7	10	17	37.8
	%	41.2	58.8	100.0	
Unmarried	No.	12	16	28	62.2
	%	42.9	57.1	100.0	

[a] Includes IHD (Sample, 1970), HHD and CRHD (1969-1970).
[b] Excluding DOA and SD.

TABLE 16

THE RELIABILITY OF ISCHEMIC HEART DISEASE DIAGNOSIS ON DEATH CERTIFICATES BY PLACE OF DEATH, OKLAHOMA CITY SAMPLE, 1970

Reliability of Diagnosis	Hospital		Nursing and Convalescent Homes		Not in Hospital or Institution	
	No.	%	No.	%	No.	%
Definite	11	18.6	0	0	0	0
Possible	9	15.3	0	0	4	16.7
Doubtful	8	13.6	9	90.0	4	16.7
Wrong	3	5.1	1	10.0	0	0
Sudden Death	28	47.4	0	0	16	66.6
Total	59	100.0	10	100.0	24	100.0
Per cent	63.4		10.8		25.8	

from hospitals and the smallest proportion, (10.8 per cent) were reported from nursing homes. All diagnoses of IHD reported from nursing homes were either doubtful or wrong. The highest agreement was among patients who died in the hospital.

Table 17 shows that of the 40 HHD deaths, the majority (67.5 per cent or 27 deaths) were reported from hospitals and the smallest number, 5 deaths (12.5 per cent) from nursing homes. Of the 5 deaths in nursing homes, 80 per cent (4 deaths) were either doubtful or wrong diagnoses. The highest agreement was 58.3 per cent (when SD was excluded) between the hospital diagnoses of HHD and the author's criteria.

All 17 deaths from CRHD were reported from hospital. Table 18 shows that of the 17 deaths 23.6 per cent had doubtful diagnoses.

In brief, the main findings of the results of Part I are as follows:

1. Among IHD and HHD (excluding SD) the proportion of agreement and disagreement between the diagnosis of cause of death on the death certificate and the author's criteria (or definite and possible diagnoses) was almost equal. Whereas among CRHD the ratio of agreement: disagreement was about 2.5:1.

2. The diagnoses of 15.9 per cent of IHD SD, who were VFD and whose bodies were found at home were definitely unreliable.

3. Agreement by type of heart disease (excluding SD) varied from 71.4 per cent for CRHD to 49.0 per cent for IHD and 47.2 per cent for HHD.

4. The reliability of the diagnosis of the total 150 sampled cases of the heart disease showed that almost half (51.5 per cent) of the diagnoses of cause of death on the death certificate were in agreement

TABLE 17

THE RELIABILITY OF HYPERTENSIVE HEART DISEASE DIAGNOSIS ON DEATH CERTIFICATES BY PLACE OF DEATH, OKLAHOMA CITY, 1969 and 1970

Reliability of Diagnosis	Place of Death					
	Hospital		Nursing and Convalescent Homes		Not in Hospital or Institution	
	No.	%	No.	%	No.	%
Definite	8	29.6	0	0	1	12.5
Possible	6	22.3	1	20.0	1	12.5
Doubtful	5	18.5	3	60.0	2	25.0
Wrong	5	18.5	1	20.0	3	37.5
Sudden Death	3	11.1	0	0	1	12.5
Total	27	100.0	5	100.0	8	100.0
Per cent	67.5		12.5		20.0	

TABLE 18

THE RELIABILITY OF CHRONIC RHEUMATIC HEART DISEASE DIAGNOSIS ON DEATH CERTIFICATES BY PLACE OF DEATH[a], OKIAHOMA CITY, 1969 and 1970

Reliability of Diagnosis	Hospital	
	No.	%
Definite	7	41.2
Possible	3	17.6
Doubtful	4	23.6
Wrong	0	0
Sudden Death	3	17.6
Total	17	100.0

[a]All 17 cases of CRHD died in the hospital.

with the author's criteria (excluding SD).

There were many factors affecting the reliability of cause of death on the death certificate in this study.

1. There were more doubtful and wrong diagnosis of IHD and HHD among females than males. Whereas among CRHD the reverse was noticed.

2. The reliability of the diagnosis of IHD was greater for Caucasian's than for Negroes, whereas the reverse was found for diagnoses of HHD.

3. The reliability of the diagnosis of the heart disease was considerably higher for both the unmarried and married male than for the unmarried and married female.

4. Of the 93 IHD deaths, 63.4 per cent; of 40 HHD deaths, 67.5 per cent and all 17 deaths from CRHD were reported from the hospitals. The highest agreement (between the diagnosis of cause of death on the death certificate and the author's criteria) was among patiens who died in the hospital.

5. The unreliability of diagnosis of heart disease as reported from nursing homes was very high: 100 per cent for IHD and was 80 per cent for HHD.

6. Another interesting finding was the incidence of SD. Of the total 150 sample deaths 51 (34.0 per cent) were SDs. The majority of the SDs, (82.4 per cent) were observed and some (17.6 per cent) were unobserved and unattended (whose bodies were found at unknown time interval after death).

7. Among IHD deaths, SD constituted 47.3 per cent; among HHD deaths, 10.0 per cent and among CRHD deaths, 17.6 per cent.

8. A majority (60.0 per cent) of IHD deaths among Negroes were

SD and the medical examiners certified a great proportion of the Negroes SDs, whereas among Caucasians 45.8 per cent of IHD deaths were SDs. The medical examiners certified only 27.5 per cent of the total 51 SDs. A majority (90.0 per cent) of the "victim found dead" category were certified by the medical examiners.

9. About 56.7 per cent of SD in IHD expired at home; 10.0 per cent at work, in a car or cafeteria. Thirty three per cent of all those SDs attributed to IHD survived long enough to be admitted to the hospital.

10. There were more SDs among males than females in the three forms of heart disease (IHD, HHD and CRHD).

Part II - Descriptive Epidemiology

This section presents a description of mortality from heart disease in Oklahoma County residents for the five year period (January 1, 1966 through December 30, 1970). The descriptive analysis provides an overall picture of heart disease mortality, which may clarify the implications of the study of the reliability study.

Secular Trend

There were a total of 7,176 deaths from the five categories of reported heart disease (IHD, HHD, CRHD, Congenital Heart Disease, and Other Forms of Heart Disease) in Oklahoma County during the five-year period. Table 19 shows that the overall estimated death rate for heart disease was 285.8 per 100,000 population (based on the estimated population for each year by the Employment Security Commission of the State of Oklahoma and the 1970 Census figures). Ischemic heart disease was the principal cause of death with 6,380 deaths (88.9 per cent of the total). Table 19 shows a declining trend for all forms of heart disease

TABLE 19

HEART DISEASE MORTALITY BY TYPE AND BY YEAR, OKLAHOMA COUNTY, 1966-1970

Type of Heart Disease (HD)	YEARS 1966	1967	1968	1969	1970	Total	% of Total	% Change in Rate 1966-1970
Ischemic HD	1,130 (234.3)	1,133 (232.7)	1,339 (271.6)	1,376 (263.7)	1,402 (266.1)	6,380 (254.1)	88.9	+13.6[b]
Hypertensive HD	64 (13.3)	51 (10.5)	20 (4.1)	29 (5.6)	19 (3.6)	183 (7.3)	2.5	-72.9[c]
Chronic Rheumatic HD	19 (3.9)	12 (2.5)	19 (3.9)	17 (3.3)	16 (3.0)	83 (3.3)	1.2	-23.0
Congenital HD	26 (5.4)	19 (3.9)	24 (4.9)	15 (2.9)	9 (1.7)	93 (3.7)	1.3	-68.5
Other Forms of HD	93 (19.3)	105 (21.6)	90 (18.3)	70 (13.4)	79 (15.0)	437 (17.4)	6.1	-22.3
Total	1,332 (276.2)	1,320 (271.1)	1,492 (302.6)	1,507 (288.8)	1,525 (289.5)	7,176 (285.8)		+4.8
Per Cent	18.6	18.4	20.8	21.0	21.0	21.2	100.0	

[a] Numbers in parentheses are rates per 100,000 population
[b] + means increased
[c] - means decreased

during this period, with the exception of ischemic heart disease. This decline is particularly remarkable in the case of hypertensive heart disease and congenital heart disease. The death rate from hypertensive heart disease dropped from 13.3 in 1966 to 3.6 per 100,000 in 1970 (which was a decrease of 72.9 per cent). The congenital heart disease death rate dropped from 5.4 in 1966 to 3.7 per 100,000 (which was a decrease of 68.5 per cent). During the same period of time the ischemic heart disease (estimated) death rate rose from 234.3 to 266.1, an increase of 13.6 per cent. The overall death rate for heart disease increased slightly from 276.2 to 289.5 per 100,000 population, an increase of 4.8 per cent.

Specific Underlying Cause of Death

During the five-year period of this study, two revisions of the ICD (7th and 8th Revisions) were used. Because of the alteration of terminology and classification of some of the diseases from the 7th to the 8th Revision, the study of the specific cause of death under each category will be presented separately for the two periods (1966-1967 and 1968-1970).

Ischemic Heart Disease. During the period 1966-1967, a majority (93.9 per cent) of 2,263 IHD deaths were reported as "arteriosclerotic heart disease including coronary disease." The remaining 6.1 per cent of the IHD deaths were coded as "chronic endocarditis not specified as rheumatic," and "other myocardial degeneration." (Table VII, Appendix B).

During the period 1968-1970, the principal cause of IHD deaths was acute myocardial infarction, 64.9 per cent and "chronic IHD," 34.7 per cent of 4,117 IHD deaths. The remaining 0.4 per cent (18 deaths)

was reported as "unspecified acute and subacute IHD" and "angina pectoris" (Table VIII, Appendix B).

Hypertensive Heart Disease. During the period 1966-1967, a majority (69.5 per cent) of the 115 deaths were reported as "other and unspecified HHD." The remaining 30.5 per cent were coded as "HHD with arterioral nephrosclerosis" and "essential malignant HHD" (Table IX, Appendix B). When the 8th Revision of ICD was used for the period 1968-1970, there were no deaths listed under the category "other and unspecified HHD" (Table X, Appendix B). During the period 1968-1970, the annual number of reported HHD deaths dropped remarkably compared to 1966-1967. The order of frequency of specific causes of death from HHD (from high to low) reported during the last three-year period was: HHD; mixed hypertensive heart and renal disease; and malignant hypertension with heart involvement.

Chronic Rheumatic Heart Disease. Deaths involving disease of the mitral and aortic valves were recorded with about the same frequency (6 and 5 deaths respectively) during the period 1966 and 1967 (Table XI, Appendix B). However, the difference was reversed and greater (9 mitral and 14 aortic deaths) during 1968 through 1970 (Table XII, Appendix B). Particularly, during the last two-year period of this study, the aortic valve disease mortality was reported with twice the frequency of mitral disease deaths. The order of frequency of specific causes of death from CRHD (from high to low) during the last three-year period was: disease of aortic valve, disease of mitral valve and mixed disease of mitral and aortic valve.

The distribution of specific underlying causes of death from congenital heart disease and other forms of heart disease, for the period 1966-1967 and 1968-1970 (which are not the main concern of this study)

are shown in Tables XIII-XVI of Appendix B. Tables XIII and XVI of the Appendix B show that "unspecified anomalies of heart" were reported with great frequency (62.3 per cent for the period 1966-1967 and 47.9 per cent for the period 1968-1970). Tables XV and XVI of Appendix B show that "total unspecified disease of heart" and "symptomatic heart disease" were reported with great frequency (68.7 per cent) for the period 1966-1967 and (86.6 per cent) for the period 1968-1970 respectively.

Sex Distribution

Figure 2 shows the sex distribution of deaths due to heart disease. In all forms of heart disease except chronic rheumatic heart disease, males predominated. (The distribution of actual numbers of the heart disease deaths by sex in Table XVII, Appendix B shows the magnitude of male preponderance in numbers of deaths). The sex difference is more clearly demonstrated by sex specific death rates for the year 1970 Table 20). For all forms, the male rate was 350.6 per 100,000; the female rate 233.4. The male excess was greatest for ischemic heart disease: 324.0 per 100,000 as compared with 213.0 for females. The ratio of the male death rate to the female death rate for ischemic heart disease was found to be about 1.5:1.

Race Distribution

Table 21 shows that the majority (91.6 per cent) of the total of 7,176 deaths from heart disease (1966-1970) occurred among Caucasians. Ischemic heart disease was the principal cause of death for all races. In order to appreciate the race variation among deaths due to various forms of heart disease, race-specific death rates were computed for 1970 (Table 22). The highest race-specific death rate was 297.0 (per

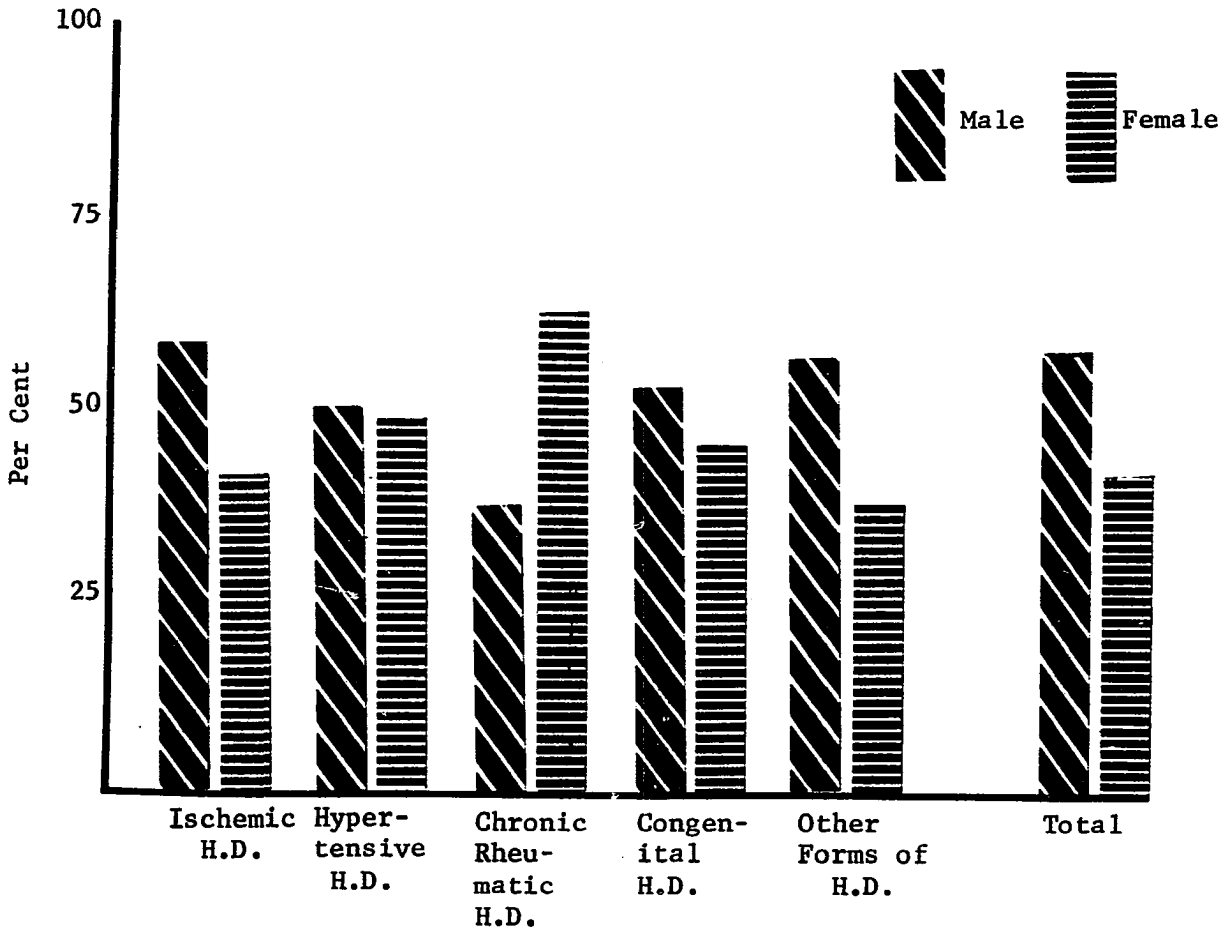


Fig. 2. Sex distribution of deaths from heart disease (H.D.), by type, Oklahoma County, 1966-1970.

TABLE 20

HEART DISEASE MORTALITY BY TYPE AND BY SEX,
OKLAHOMA COUNTY, 1970

Heart Disease (HD)	Male	Female	Total	%
Ischemic HD	817 (324.0)[a]	585 (213.0)	1,402 (266.1)	91.9
Hypertensive HD	12 (4.8)	7 (2.5)	19 (3.6)	1.2
Chronic Rheumatic HD	6 (2.4)	10 (3.6)	16 (3.0)	1.1
Congenital HD	7 (2.8)	2 (0.7)	9 (1.7)	0.6
Other Forms of HD	42 (16.7)	37 (13.5)	79 (15.0)	5.2
Total	884 (350.6)	641 (233.4)	1,525 (289.5)	100.0

[a]Numbers in parentheses are rates per 100,000 population.

TABLE 21

HEART DISEASE MORTALITY BY TYPE AND BY RACE,
OKLAHOMA COUNTY, 1966-1970

Heart Disease (HD)	Caucasian	Negro	Indian	Total
Ischemic HD	5,929 (92.9)[a]	416 (6.5)	35 (0.6)	6,380 (100.0)
Hypertensive HD	134 (73.2)	49 (26.8)	0 (0)	183 (100.0)
Chronic Rheumatic HD	78 (94.0)	4 (4.8)	1 (1.2)	83 (100.0)
Congenital HD	79 (84.9)	11 (11.9)	3 (3.2)	93 (100.0)
Other Forms of HD	355 (81.2)	80 (18.3)	2 (0.5)	437 (100.0)
Total	6,575 (91.6)	560 (7.8)	41 (0.6)	7,176 (100.0)

[a]Numbers in parentheses are per cent of total of each row.

TABLE 22

HEART DISEASE MORTALITY, BY TYPE AND BY RACE,
OKLAHOMA COUNTY, 1970

Heart Disease (HD)	Caucasian	Negro	Indian
Ischemic HD	1,275 (276.0)[a]	117 (221.8)	10 (96.7)
Hypertensive HD	14 (3.0)	5 (9.5)	0
Chronic Rheumatic HD	15 (3.2)	1 (1.9)	0
Congenital HD	8 (1.7)	1 (1.9)	0
Other Forms of HD	60 (13.0)	19 (36.0)	0
Total	1,372 (297.0)	143 (271.1)	10 (96.7)

[a]Numbers in parentheses are rates per 100,000 population.

100,000 Caucasian population) for all forms of heart disease. The ischemic heart disease death rate was higher than other forms among all races. Table 22 also shows that the race specific death rate for ischemic heart disease was highest for Caucasians. Although the total number of deaths was greatest for Caucasians in all forms of heart disease (Table 21), the race specific death rate from HHD was highest among Negroes (Table 22).

Projection of Diagnostic Rate of IHD

Should we project the proportion of definite, possible, doubtful, wrong and sudden death diagnoses into the deaths from IHD from 1968 to 1970, we see that of the total 2,924 deaths occuring during this three-year period, 755 (25.8 per cent) would have been reliable (definite and possible) diagnosis; 787 (26.9 per cent) were unreliable (doubtful and wrong diagnosis, and 1,382 (47.3 per cent) were sudden death (Table 23). When we project the proportion of DOA, VFD and unexpected deaths (found in Part I) into the 1,382 sudden deaths, we see that 817 (59.1 per cent would have been VFD, and 314 (22.7 per cent) would have been unexpected deaths.

Diagnostic ratings were not projected for HHD and CRHD, because the number of deaths from HHD and CRHD in 1968 was too small.

Age Distribution

After age 30, the number of deaths from heart disease increased with age up to age 85 years (Table XVIII, Appendix B). The highest number of deaths from congenital heart disease was in the age group under 5 years. The highest age specific death rate was 7187.2 per 100,000 population in the age group 85 and over (Table XIX, Appendix B).

TABLE 23

SAMPLE RATING APPLIED TO ALL OKLAHOMA CITY DEATHS FROM ISCHEMIC HEART DISEASE BY YEAR, 1968-1970

Reliability of Diagnosis	% in Sample	Estimated Number of Deaths
Definite	11.8	345
Possible	14.0	410
Doubtful	22.6	661
Wrong	4.3	126
Sudden Death	47.3	1,382
Total	100.0	2,924

Place of Death

Of the 7,176 deaths from heart diseases in Oklahoma County 52.0 per cent were reported from hospitals, 13.2 per cent from nursing homes and the remaining 34.8 per cent from other places (Table XX, Appendix B). When one compares the place of death for the various forms of heart diseases, the highest proportion of deaths reported from hospitals were among those classified as congenital heart disease (89.2 per cent). Half, (50.8 per cent) of the ischemic heart disease deaths were reported from hospitals (Table XX, Appendix B).

In brief, the main findings of the result of the Part II are as follows:

1. There were a total of 7,176 deaths from five forms of reported heart disease (IHD, HHD, CRHD, Congenital Heart Disease and Other Forms of Heart Disease) in Oklahoma County during the five-year period of this study, 1966-1970.

2. The principal cause of death was IHD with a rate of 254.1 per 100,000 population.

3. Another point of interest is the great frequency of "other and unspecified HHD" (69.5 per cent of total 115 HHD deaths) during the period 1966-1967. Interestingly, when the 8th Revision of ICD was used for the period 1968-1970, there were no deaths listed under the category "other and unspecified HHD".

4. The mortality trend from each form of heart disease decreased except IHD, which increased from 1966-1970. Because of the upward trend of IHD, the overall trend of the total estimated heart disease death rate increased (from 276.2 in 1966 to 289.5 in 1970, an increase of 4.8 per cent).

CHAPTER V

DISCUSSION

The assessment of the public health importance of cardiovascular-renal (CVR) disease has been based almost entirely on mortality statistics until recent years (Moriyama et al., 1971). Various population surveys have recently provided information on the dimensions of certain morbidity aspects of different components of the CVR disease complex. However, satisfactory estimates of incidence and prevalence are not yet available for the total complex of CVR disease, or for the total population of the United States (Moriyama et al., 1971).

The descriptive phase of the present study of heart disease mortality attempts to compare some of the features of heart disease mortality among Oklahoma County residents with the findings of other investigators. The variables most commonly examined in descriptive epidemiology have been classified as descriptive of time, place and person (MacMahon and Pugh, 1970). The variable of place was determined in this study by limiting the investigation to Oklahoma County residents. Therefore, this study has included some of the time and person variables.

Secular Mortality Trend

As a cause of death, and as a proportion of deaths from all causes, the CVR diseases appear to have increased in recent decades

(Borhani, 1965). Borhani (1965) reported that approximately 1 out of every 200 persons in the U. S. dies each year as the result of CVR disease. These diseases account for 54.8 per cent of deaths from all causes.

In the present study, the death rates from IHD was 266.1, from HHD was 3.6, from CRHD was 3.0 and for the total heart disease was 289.5 per 100,000 population in Oklahoma County in 1970. According to the National Center for Health Statistics cited by Long et al. (1968-1972), the national death rate from IHD was 324.9, from HHD was 7.4, from CRHD (including active rheumatic fever) was 7.6 and for total heart disease was 359.0 per 100,000 population in 1970, considerably higher than the death rates of Oklahoma County in 1970.

In the present study, 88.9 per cent of the heart disease deaths were attributed to IHD, 2.5 per cent were attributed to HHD and 1.2 per cent were attributed to CRHD. The other forms of heart disease were held responsible for the remaining 7.4 per cent of these deaths. Although the methods and materials of Borhani (1965) study was different from the present study and included total CVR disease, it is interesting to look the result of the two studies. Borhani found that about 55 per cent of CVR disease deaths were attributed to IHD, 20.3 per cent were attributed to vascular lesions affecting the central nervous system (stroke) and 6.1 per cent were attributed to HHD. All other forms of heart disease were held responsible for 18.6 per cent of the CVR deaths. In both, the Borhani study and present study, IHD was the principal cause of death.

During the past 35 years, some fundamental changes have occurred in medical concepts, diagnostic skill and disease classification.

Therefore, it is virtually impossible to reconstruct valid long term trends for the components of CVR disease. Only the total category of CVR disease appears to be reliable enough to serve as the basis for interpretation of the long term or secular trends in mortality (Borhani, 1965). Therefore, recognizing the problems of constructing a valid long term study of trends of the components of CVR disease, a short term study of a five year mortality trend was undertaken for the present investigation.

The results of the mortality trend in this study indicated that death rates for each form of heart disease decreased except IHD which increased (from 1966-1970). The upward trend of IHD in the present study is in agreement with reports of an increasing prevelance of IHD by Stamler (1962); Acheson (1962); Moriyama (1964); Epstein (1965) and Wells (1969).

Acheson (1962) believed that the upward trend of IHD is largely real. However, Borhani (1965) believed the increase in the proportion of CVR mortality during the past half century to be attributable largely to the increasing percentage of older persons in the population. When corrections were made for the age change in the population, it would be evident that the death rate from all CVR disease has actually been declining since 1930.

Furthermore, because of recent advances in medical science, deaths attributable to RHD, congenital heart disease, and syphilitic heart disease have been on the decline since the end of World War II. As a consequence, the proportion of deaths from CVR disease due to degenerative and arteriosclerotic diseases of the heart and blood vessels has increased (Borhani, 1965).

In the present study, the variation of the mortality trend, particularly in the case of IHD and HHD could be partly explained, if not totally, by several circumstances. The death rate for HHD dropped from 10.5 in 1967 to 4.1 per 100,000 population in 1968, a decrease of 61 per cent, coinciding with the adoption of Eighth Revision of the ICD. Afterwards, the death rate from HHD fluctuated up and down during the years 1969 and 1970 (see Table 19). During the same time, and in contrast to the HHD death rate, the rate for IHD increased from 232.7 in 1967 to 271.6 per 100,000 population in 1968, an increase of 21 per cent, again coinciding with the adoption of the Eighth Revision of the ICD. Afterwards, the death rate from IHD fluctuated down and up during the years 1969 and 1970 but inversely to HHD (see Table 19).

The findings of this study are in agreement with the national data of the National Center for Health Statistics cited by Long et al. (1968-1972). The national estimated death rate (per 100,000 population) from IHD for the United States increased from 290.9 in 1967 to 338.9 in 1968, an increase of 16.6 per cent. Simultaneously, and in contrast to the IHD death rate, the estimated death rate from HHD dropped markedly from 25.2 in 1967 to 5.0 in 1968, a decrease of 80 per cent. These changes in death rates coincided with the adoption of the Eighth Revision of the ICD. The overall death rate from heart disease increased from 276.2 in 1966 to 289.5 in 1970, an increase of 4.8 per cent. Long et al. (1968-1972) reported that the national death rate from heart disease dropped from 375.1 in 1966 to 359.0 per 100,000 population in 1970, a decrease of 4.4 per cent.

In general, the conclusion of this study are in agreement with the report of Bogue (1969); Moriyama (1960); Wells (1969); and the World

Health Organization Expert Committee on Health Statistics (1950). It would appear that the apparent upward trend in IHD mortality can be partly, if not largely, explained by shifts of medical terms from one cause of death group to another in the periodical revision of the International List of Deaths (namely from the Seventh Revision to the Eighth Revision in this study). Another factor which also incluenced the IHD upward trend may be the changing diagnostic fashion regarding IHD. IHD emerged from obscurity early this century and became a major public health problem in the U. S. (Morris and Gardner, 1969).

Sex Differential

A point of interest is the male preponderance. The sex-specific death rate of IHD for males (324.0) was much higher than was the female rate (213.0 per 100,000 population) in this study. Evidence has been presented in other studies that a combination of some or all of the following individual variables such as: cholesterol, high blood pressure, diabetes, phospholipids, body build, overweight, tobacco smoking, uric acid, emotional stress and a specific overt behavior (aggresiveness, ambition, drive, competitiveness and a profound sense of time urgency) might contribute to this male preponderance (Garcia-Palmieri et al., 1965; Moriyama et al., 1971; American Heart Association, 1965, 1968 and 1970; Blackburn and Willis, 1969; Mulcahy et al., 1969; Stamler, 1967; Borhani, 1965; Raab, 1966; Epstein et al., 1965; Dawber et al., 1957).

Another interesting speculation regarding the high sex ratio differences of death rates is that ovarian hormone secretion inhibits the atherosclerotic process, particularly the anatomic and clinical manifestations (Eisenberg et al., 1961), possibly through the influence of estrogen on the composition of serum lipoproteins. McDonough (1965)

also reported that there is a relative protection of females in the pre-menopausal period which is lost during the years following menopause (cessation of ovarian function markedly reduces estrogen production in the menopausal and post-menopausal period).

Race Differences

The race-specific death rate for IHD and CRHD in the present study indicates a Caucasian preponderance (Table 22). During the same time, the race-specific death rate for HHD shows that the Negro rate is three times that of the Caucasian death rate. The Caucasian preponderance of IHD has also been reported by other investigators (McDonough, 1965; Stamler, 1967 and Modern Medicine Editorial, 1970).

Stamler et al., 1961 and McDonough (1965) suggested that social class differences may explain the race differences in IHD. McDonough (1965) found that low social class white males had an IHD prevalence ratio similar to the ratio for Negro males, and significantly lower than the ratio for high social class white males. The pattern for serum cholesterol was exactly the same: low social class whites and Negroes had levels that were similar and significantly lower than the levels for high social class whites. McDonough also reported that social class differences, for both IHD and serum cholesterol, could be related to occupation. Nearly all Negroes in his study worked as laborers or share-croppers, as did the low social class whites.

McDonough (1965) and McDonough et al., (1964) concluded that genetic factors could not explain the Negro-white difference. Neither could cigarette smoking explain the excess IHD prevalence among whites. They postulated that differences in caloric balance occur between Negro

and white males since Negro males have significantly more calories in the diet, and weight significantly less. Caloric intake and body weight do not differ significantly when high and low social class white males are compared, although the differences are suggestive in the direction of a higher caloric intake and lower body weight for the low social class. Differences in fat intake could not explain the variation in IHD and serum cholesterol, because the high social class white males had the lower intake of animal fat (McDonough, 1965). He also reported that physically active groups have a significantly lower prevalence of IHD. Thus, it is reasonable to suppose that differences in physical activity may account for the difference in IHD and serum cholesterol observed between the various occupations, social classes, and racial groups. It may be that the effect of physical activity upon cholesterol is an adequate explanation of the effect of activity upon IHD; however, this is not universally accepted. Karvonen et al., (1961) noted in Finland that differences in serum cholesterol did not occur between physically active wood cutters as compared to more sedentary men.

From these opinions and studies, one may conclude only that the field remains in a state of ignorance regarding many of the factors surrounding the etiology and pathogenesis of IHD.

Another point of interest in the present study is the racial difference in HHD. Negroes had a race-specific death rate more than three times higher than whites in 1970 (Table 22). These data agree with other studies showing an excess mortality from hypertensive disease among Negroes in the United States (Moriyama and Woolsey, 1951; Hutcheson et al., 1953; Moriyama, 1960; McDonough et al., 1964; U.S. National Health Survey, 1965; and Burch, 1971). McDonough et al.,

(1964) reported that the lower social status and different occupational distribution of Negroes as compared to whites cannot explain the excess of HHD deaths occurring among Negroes. This, of course, does not exclude possible environmental influences which might act more commonly on Negroes than whites but which are not associated with social class or occupation. One such factor might be salt ingestion. McDonough et al., (1964) felt that the preliminary report of an investigation of salt eating practices of a sample of Negroes and whites in Evans County indicated that salt intake does not explain the difference in blood pressure.

Saunders and Bancroft (1942) and McDonough et al., (1964) reported that possible differences in medical management are inadequate to explain the racial prevalence difference in HHD.

On the question of the inheritance of hypertension, most investigators agree that a genetic component does exist (Pickering, 1961; Platt, 1961).

Since none of these inferences were tested in this study, they should be regarded as hypothetical speculation.

Reliability

Accuracy of death certification is a subject which should be of interest to all physicians, epidemiologists, statisticians and health care planners. However, it has received surprisingly little attention (Bourke, 1969; Flore et al., 1969).

Within the limits of prevailing medical knowledge, the accuracy of medical records and the completeness of cause of death statements depend upon 1) availability of pertinent diagnostic information; 2) diagnostic acumen on the part of the physician; 3) the manner in which diag-

noses are reported on the death certificate, and 4) coding accuracy of the registrar of vital statistics. This dissertation took under consideration the effect of all these factors in estimating the degree of reliability of cause of death from heart disease on the death certificates.

When SDs were excluded, almost half (51.5 per cent) of the cause of death statements on the death certificates from the three forms of heart disease (IHD, HHD and CRHD) were in agreement with the author's criteria for diagnosis of heart disease. The percentage of reliability by forms of heart disease varied from 71.4 per cent for CRHD to 49.0 per cent for IHD and 47.2 per cent for HHD.

Comparison of the present study with findings of other investigators indicates that some author's found greater and some less agreement. Moriyama et al., (1958), using a questionnaire method, found 79 per cent agreement for all diseases; for rheumatic fever and rheumatic heart disease, 83 per cent; for arteriosclerotic heart disease, 76 per cent and for hypertensive disease 76 per cent. Thus they found higher reliability than the present study. James et al., (1955) in a study of 1,889 autopsies found an overall agreement of 71.0 per cent for various diseases. In their study, the agreement for CRHD was 73.2 per cent; for HHD was 17.1 per cent and IHD 73.2 per cent.

Discrepancies between studies may be due to several factors: the type of disease included; the type of study (autopsy study or review of the medical record or a questionnaire study, or all three combined); the population under study and the sampling procedure (hospital patients, non-hospitalized patients or random sample); the author's criteria for the diagnosis; the progress of medical knowledge; and changes in diag-

nostic fashion over the years. Medical knowledge and facilities for diagnosis are progressing, but vary from place to place (Densen, 1965). Another important factor influencing these discrepancies is the periodical change in the list of the ICD.

Factors Affecting the Reliability

The unreliability of cause of death statements which was found in the present study may be attributed to some or all of the following factors:

Place of Death. As shown in Table 16, there was a difference in reliability of diagnosis related to the place of death. Diagnoses showing the highest agreement were from hospitals, and the lowest agreement from nursing homes. This may well reflect the intensity of diagnostic effort which is generally present in hospitals

Sex. The unreliability of diagnosis of cause of death was higher for females (57.8 per cent) than for males (40.7 per cent). The higher disagreement among females could be partly, if not largely, explained by the difference in place of death. A majority (81.5 per cent) of the male deaths but only about half (51.5 per cent) of the female deaths occurred in the hospital. Similarly, a considerably higher proportion of female than male deaths occurred in nursing homes.

Marital Status. The greater unreliability of diagnosis of cause of death found among females may also be partially explained by the differences in marital status. Among females, the ratio of married to unmarried was about 1 to 2. Among males, the ratio of married to unmarried was almost 5 to 1 (see Table 15)[2]. Among married males, there

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[2]This ratio is higher than the proportion of married to unmarried in the general population 14 years old and over (74.2 per cent married; 25.8 per cent unmarried for male, Oklahoma City residents in 1970 Census).

was a 61.4 per cent reliable diagnosis. At the same among unmarried males, only 50 per cent of the diagnoses were reliable. The proportion of reliable diagnoses was less for both married and unmarried females than for males generally. This again might be due to the previous findings that in comparison to males, a higher proportion of females (both married and unmarried) died outside of the hospital.

Physician and Coder. The accuracy of the statement concerning the cause of death increases with the development of understanding on the part of the physician and coder of the importance of accurate completion and coding of the medical portion of the death certificate. A few physicians did not record the underlying cause of death correctly (according to the List of the ICD) on the death certificate. In a few cases, inaccuracy occurred because of mistakes in coding. Such findings were also reported by American Public Health Association (1958); Densen, (1965).

Underlying Cause of Death. There was a great deal of variation in the reliability of the diagnosis of cause of death among the three types of heart disease studied. Reliable diagnoses were more frequent among those certificates coded as acute myocardial infarction than among chronic IHD in the present study (see Table 1). Perhaps, because of the acuteness and seriousness of acute myocardial infarction, the physician was more concerned and performed more diagnostic procedures than he might in any particular case of chronic IHD. The overall unreliability of diagnoses (excluding SD) for IHD was 51.0 per cent.

Among the category "hypertensive heart and renal disease" deaths, unreliability of the diagnoses was higher than among deaths coded only as HHD. The overall unreliability of diagnosis for HHD was

52.8 per cent.

Among all forms of CRHD deaths, diagnoses were more reliable. The overall unreliability of diagnoses was 28.6 per cent.

These differences in reliability between the diseases may be related to the place of death. About one third of IHD and HHD cases died outside hospitals, whereas all CRHD deaths occurred in the hospitals.

Both the review of the literature and the result of present study have pointed out the existence of considerable overall disagreement for various diseases. In the present study there was a wide range of unreliability from 52.8 per cent for HHD and 51.0 per cent of IHD to 28.6 per cent for CRHD. For some other diseases reliablity was even lower, according to other investigators (Moriyama et al., 1958 and 1971; James et al., 1955; Cabot, 1912; the WHO Expert Committee on Health Statistics, 1950; Aase, 1960; Dorn and Horn, 1941; and Kagan et al., 1967a; Calhoun et al., 1963).

If one should apply the 51 per cent proportion of unreliability in diagnosis of IHD as a cause of death found in this study to the 1,542 deaths said to be due to IHD, (1,382 Sudden Deaths due to IHD were excluded here, which will be discussed later) in Oklahoma City during 1968 through 1970 (see Table 23), the following conclusion can be made: of the 1,542 IHD deaths, 786 of them could be unreliable diagnoses. When the high proportion of unreliable diagnoses (51.0 per cent for IHD; 52.8 per cent for HHD and 28.6 per cent for CRHD), is considered, one must raise serious doubts about the use of current death certificate data for research purposes. The epidemiological study of deaths from heart disease based on such information must be re-examined to determine

whether there is significant bias in the way the errors are associated with the factors under investigation. Material to be used for such studies must first be refined. A similar conclusion has been suggested by other investigators. The WHO Expert Committee on Health Statistics (1950) stated that for various reasons, the diagnoses recorded on death certificates form an insecure foundation upon which to build knowledge relative to the incidence of disease. James et al., (1955) concluded that, although a large number of death certificates give an inaccurate cause of death, this error does not necessarily exert a great influence on the overall "cause of death" statistics. Approximately the same number of deaths from cancer, for example, are reported to be due to heart disease as there are heart disease deaths which are attributed to cancer. Although such a compensating mechanism may give more confidence in the overall mortality statistics, it raises much insecurity about the use of the death certificate data for research, especially in the study of the chronic degenerative diseases. Beadenkopf et al., (1963) concluded that, the death certificate data were found to be somewhat inadequate in sensitivity for identifying cases of IHD. They found 50 per cent of the individuals with infarction or coronary thrombosis at autopsy recorded IHD on the death certificate.

It could be concluded from the results of this study that in order for the death certificate materials to be used for research purposes, they need to be refined and adjusted for the proportion of unreliability of diagnosis.

Sudden Death

It was noted in the present study as well in others (Kuller et

al., 1966b and 1967; Paul, 1971) that because of the rapidity of SD, clinical data to support the diagnosis of IHD, as listed on the death certificate, are meager. As the American Heart Association (1960) recommended[3], attempts have been made in this study to separate those cases in which there has been an eye witness and in which the time interval (from onset to death) of unexpected SD has been recorded. This group has been separated from those unobserved deaths in which the body was found at an unknown interval of time after death occurred with no witness as to the exact circumstance and their duration (see Table 8). The result of this study indicated that among 44 SDs from IHD, 59.1 per cent were DOAs, 22.7 per cent were unexpected deaths, and 18.2 per cent were VFD. The DOA and unexpected deaths were instantaneous SDs, observed either by medical or non-medical personnel. The VFD were unwitnessed and unobserved SDs.

Incidence of SD. Of the 93 IHD deaths among Oklahoma City residents in 1970, the incidence of SD was 47.3 per cent. Of the 40 HHD deaths, 10 per cent were SD and of the 17 CRHD deaths, 17.6 per cent were SDs.

The comparison of the incidence of SD in the present study with the findings of other investigators indicates that some found higher and some found almost the same relative frequency of SD. Paul

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[3]The American Heart Association (1960) stated that, "in the absence of adequate clinical, laboratory, or post-mortem findings, the use of unexplained sudden death as evidence of coronary artherosclerosis with IHD is at present not acceptable." They also stated that, "SD included those cases in which there has been an eye witness and where the unexplained or unexpected SD have occurred within a matter of minutes. This group of cases should be separated from unobserved deaths in which the body was found at an unknown interval of time after death occurred with no witness as to exact circumstance or their duration. (page 34).

(1971) reported that SD is the first clinical manifestation of acute myocardial infarction in 20 to 25 per cent of cases. Of more than 500,000 coronary deaths per year, about 60 per cent are SD, occurring apparently without warning. In a retrospective study of SD in Baltimore by Kuller et al., (1966 and 1967), 60 per cent of IHD deaths were SDs. The incidence of SD among IHD in these studies is higher than noted in the present series. The Framingham prospective community study cited by Paul (1971), reported that half of the 120 coronary deaths were sudden. In the prospective study by Paul (1971), half of the coronary deaths were SDs. The incidence of SD among IHD in these studies was almost equal to the present series.

According to the WHO Expert Committee (1959) and the American Heart Association (1960)[4], the diagnoses of IHD reported as DOAs, and unexpected SDs (which might have been instantaneous deaths) are reliable diagnoses. This constitutes 81.8 per cent of the 44 reported SD due to IHD. The remaining 18.2 per cent of the SDs reported as VFD due to IHD were unobserved and unwitnessed deaths. The body of one VFD was found in his car and this was the only case of SD on which an autopsy was performed and it showed advanced trivessel atherosclerosis. The bodies of the remaining 15.9 per cent (who died at home) were found at an unknown time following death. There was therefore no information about the time interval between the onset of symptoms and death. The diagnoses of these 15.9 per cent VFD according to the statements of WHO Expert Committee (1959) and the American Heart Association (1960) are

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[4]"at the present time there is insufficient quantitative evidence to justify the use of SD as an index of frequency of IHD, except in the case of instantaneous death." (pages 17 and 21 respectively).

unreliable.

When one applies the result of the reliability findings of the SD in this study to the 1,382 estimated IHD SD in Oklahoma City during 1968 through 1970 (see Table 23), the following conclusion could be made: of the 1,382 IHD SD, 15.9 per cent (220 deaths) could be VFD, which, according to the statement of the WHO Expert Committee (1959) and the American Heart Association (1960) are considered unreliable.

The presence of 15.9 per cent unreliable diagnoses of SDs due to IHD, shows the inherent inaccuracy of the cause of death certification of SD. When one excludes the 15.9 per cent unreliable diagnoses from the total number of IHD sudden deaths, the epidemiological features, rates and ratios will be altered. This finding also confirms the conclusion made earlier, that the presence of such a high degree of unreliability in the death certificate, raises serious doubts about the use of current mortality data for research purposes. There is not sufficient reason at the present time to justify the use of SD as an indicator of IHD, except in observed, witnessed and instantaneous deaths.

Sex Difference of SD. The incidence of SD among males was almost twice that of females in the present study. Dawber et al. (1964) found a much higher male to female ratio (9:1) than the present study.

Race Differences of SD. Among Negroes 60.0 per cent of IHD deaths were SD which was considerably higher than the 45.8 per cent among Caucasians. This finding was similar to the report of Kuller (1966). They found the proportion of SD among Negro males to be 71.5 per cent as compared to 45.5 per cent among white males. Such results may reflect a social and class role. The families of the deceased in the higher socio-economic classes might have obtained a physician to certify the cause of

death even in SD. Another point to be considered is that the medical examiner certified 37.5 per cent of the Negro SDs as compared with 25.6 per cent of Caucasian SD. This finding in Oklahoma City is in agreement with the reports from other cities (Breslow and Buell, 1960; Stamler, 1960; and Kuller et al., 1966a; Croce and Boseda, 1960).

Certifier of SD. Most of the previous studies of sudden and unexpected death have been primarily limited to deaths that were referred to the medical examiner's office (Helpern and Rabson, 1945; Stamler et al., 1960; Croce and Noseda, 1960; Spain et al., 1960; Adelson et al., 1961). However, the present study of sudden and unexpected deaths is not limited to the deaths that were referred to medical examiner's office. It also included SD that was certified by other physicians. In the present study only 27.5 per cent of the SD were certified by a medical examiner, 63.8 per cent were certified by a hospital physician and 8.7 per cent were certified by other physicians. This study showed clearly that medical examiners do not certify all sudden and unexpected deaths. The studies limited only to medical examiners records do not show the complete picture of SD.

Place of Death of SD. Paul (1971) reported that according to several studies, only a small fraction of sudden coronary deaths (between 2 and 5 per cent) are preceded by strenuous physical activity; somewhat more (8 to 12 per cent) occur at work. In contrast, at least half of the victims are stricken at home, most often while in bed. In the present series a similar pattern was noticed. Ten per cent of the SD attributed to IHD were stricken in a cafeteria, car or at work. Fifty-seven per cent of IHD SD expired at home and only 33.3 per cent of those who subsequently had a sudden death due to IHD survived long enough to

be admitted to a hospital. The last group survived in the emergency room from five minutes up to about two hours. Because of the rapidity of death, apparently it was not possible to obtain detailed clinical information.

CHAPTER VI

SUMMARY AND CONCLUSIONS

This study was developed in two parts: Part I had the specific objective of estimating the reliability of diagnosis of cause of death on the death certificate from the three major categories of heart disease (IHD, HHD and CRHD) among Oklahoma City residents. It was planned to analyse a sample of 159 deaths: a random sample of 100 (10.1 per cent) deaths from IHD in 1970; and all deaths from HHD and CRHD (41 and 18 respectively) in 1969 and 1970. The original death certificates of the 159 deaths were obtained from the Division of Vital Statistics of Oklahoma State Department of Health. Clinical and demographic information concerning 150 deaths were obtained on pre-designed forms from hospitals, nursing and convalescent homes, physician's offices and medical examiner's office. Clinical information could not be obtained for nine cases (seven IHD, one HHD, and one CRHD) which were omitted from the analysis.

All 150 cases were judged by pre-determined clinical criteria established by the author, and each case was assigned either into a reliable or unreliable category.

Part II consisted of a descriptive epidemiological analysis of 7,176 deaths from all types of heart diseases (IHD; HHD; CRHD; congenital heart disease and other forms of heart disease) among Oklahoma County

residents for the five year period, January 1, 1966 through December 30, 1970. The data were obtained from the death certificate records of the Division of Vital Statistics of the Oklahoma State Department of Health.

The principal cause of death (with and estimated rate 254.1 per 100,000) was IHD, among Oklahoma County residents during the period 1966-1970. A majority of the IHD deaths was attributed to acute myocardial infarction.

Mortality from each form of heart disease decreased, except IHD which increased from 1966-1970. Because of the upward trend of IHD, the overall trend of the total estimated heart disease death rate increased (from 276.2 in 1966 to 289.5 in 1970), an increase of 4.8 per cent).

It would appear that the upward trend in IHD mortality can be partly, if not largely, explained by shifts of medical terms from one cause of death group to another as a result of a periodic revision of the International List of Cause of Death (namely from the Seventh Revision to the Eighth).

The result of reliability study indicated that almost half (51.5 per cent) of the 150 sampled cases showed diagnoses of cause of death which were in agreement with the author's criteria for a reliable diagnosis. The proportion of agreement by type of heart disease varied from 71.4 per cent for CRHD to 49.0 per cent for IHD and 47.2 per cent for HHD.

There were several factors which correlated with the determined reliability of the cause-of-death statements on the death certificates.

1. In a few cases, inaccuracies resulted from a mistake in the recording and coding of the underlying cause of death according to the

List of ICD.

2. A high (76.7 per cent) frequency of unreliable diagnoses was present among the cases dying outside of the hospital. Unreliability was much higher among those who died in nursing homes than among those who died in hospitals.

3. There were more unreliable diagnoses among chronic IHD than among acute myocardial infarction. Diagnoses listing hypertensive heart and renal disease as the cause of death were less reliable than hypertensive heart disease. Among all types of CRHD deaths, reliability was fairly high.

4. The disagreement between the cause of death statement on the death certificate and the author's criteria was higher among unmarried than among married people; also higher for females (57.8 per cent) than for males (40.7 per cent). This may be related to the fact that more married than unmarried and more males than females died in a hospital.

It is concluded that the presence of such high unreliability of diagnosis of the cause of death raises doubts about the use of present death certificate data in Oklahoma City for research purposes in the field of heart disease. Epidemiological study of deaths from heart disease based on such uncertainty should be re-examined to determine whether there is significant bias in the way the errors are associated with the factors under investigation. Material to be used for such studies should be refined and adjusted with this uncertainty in mind.

Furthermore, an interesting finding in this study was the incidence of sudden death (SD). Among IHD deaths, SD constituted 47.3 per cent; among HHD, 10.0 per cent; and among CRHD deaths 17.6 per cent. Of

the total 150 deaths, 51 (34.0 per cent) were SD. Of the IHD SDs, 15.9 per cent were unobserved and unattended, without any evidence of IHD, their bodies were found at an unknown time interval after death. Only one autopsy was performed on an IHD SD case. The diagnoses of the underlying cause of death among this 15.9 per cent according to the American Heart Association (1960) criteria, are not reliable.

Among Negroes, a majority (60.0 per cent) of IHD deaths was SD and the medical examiners certified a greater proportion of the Negroes' SDs.

The medical examiners certified only 27.5 per cent of all SDs studied. A majority (90.0 per cent) of the victims found dead (VFD) were certified by the medical examiners.

Fifty-seven per cent of IHD SDs expired at home; 10.0 per cent at work, in a car or cafeteria. Thirty-three per cent of all those SDs attributed to IHD survived long enough to be admitted to hospital.

Because of the lack of uniformity of the recording of signs and symptoms and the unknown time interval from onset to death in most cases, the author is in agreement with the WHO Expert Committee (1950) and the American Heart Association (1960) statement that "at the present time there is insufficient quantitative evidence to justify the use of sudden death as an index of frequency of IHD, except in the case of instantaneous death" (Page 17 and 21 respectively).

Suggestions and Recommendations

This study, as well as others cited, indicates a need for procedures that will improve the accuracy of reporting deaths due to ischemic, hypertensive and chronic rheumatic heart disease.

One possible method of decreasing the frequency of inaccurate cause-of-death statements on death certificates is to increase the number of autopsies. The pathologist might be asked to send a copy of each autopsy summary to the local health department (as they are sending to the referring physician). This practice should assist with the ultimate accuracy of cause-of-death statements and also help in the resolution of many of the questions posed by present death certification. It should also reduce the number of certificates requiring queries to the attending physician.

Much improvement in the accuracy of medical certification of cause of death can probably be brought about by increased efforts to motivate physicians to appreciate that death certificates are an important data source for research into the understanding of disease and to make each cause of death statement a carefully considered diagnosis.

Another possible way of reducing the frequency of unreliable diagnoses would be by publishing and distributing an up-to-date manual of standard criteria at least for major cardiovascular diseases.

A clear definition of "underlying cause of death" distributed to physicians might be helpful in preventing confusion in this regard. In practice, however, there are a number of difficult problems with which to contend.

To differentiate the underlying cause of death from the immedi-

ate cause-of-death on the death certificate is often not a simple matter. This problem becomes more complicated in chronic disease, particularly in those cases in which several degenerative processes have been at work. With an increasing aged segment of the population and decreasing frequency of communicable diseases, the problems of chronic degenerative diseases are increasing. For this reason, there may need to be a revision of the concept of "underlying cause of death" on the death certificate.

It should be a recognized responsibility of the medical staff in teaching hospitals to ensure that students and house officers are taught correct procedures concerning death certification, and the importance of these procedures should be stressed and explained.

Even if complete accuracy in death certification could be obtained, it is likely that there will be coding errors related to the cause of death. Although the rules for coding are clearly stated in the International Classification of Diseases (particularly in the Eighth Revision), their interpretation varies from place to place and from person to person. The coder's knowledge of coding, his interest and his precision, all have an important role in the accuracy of the recording of the cause of death.

One possible method to prevent some of the inaccuracies might be to maintain an alert, medically oriented person at local and state health departments to go over the medical section of the death certificates to check for completeness and coding.

The County Medical Director or Commissioner of Health might improve the accuracy of the cause of death statement on the death certificate by periodically sending letters to all practitioners in the state,

enclosing a list of indefinite or vague terms which should not be used without further elaboration on death certificates.

There is an urgent need for improvement of the certification of cause of death from heart disease reported from nursing homes. It would appear that better communications between hospitals and nursing homes, between physicians and nursing homes, might improve the accuracy in this area.

Because of the periodic revisions in classification in the ICD, the study of mortality trends may be somewhat artificial, and an apparent changing trend may reflect only a classification change.

In regard to sudden death, it might be appropriate to alter the certificate form such that sudden death might be recognized along with the underlying factor. Again an alert registrar might check the time interval from onset to death on the death certificate.

The presence of a substantial proportion of VFD and patients who died at home, suggests a delay in securing needed medical help on the part of the patient. A most challenging problem is the reduction of the interval between the onset of symptoms and the patient's call for medical aid. As long as the major source of delay in securing needed medical help is generated by the patient himself, innovation along these lines will probably have only a limited effect on mortality. In terms of priorities, major emphasis must be placed on finding ways to reduce the patient's decision time. There is currently not only a need for improved community facilities for the pre-hospital phase of coronary care but also an awareness of the role of the patient in deciding when to seek emergency medical aid (Dana, 1970).

There is also a need for more rapid and sophisticated medical

response to a call for medical assistance. It has been shown that prompt medical intervention in the course of a myocardial infarction can reduce the risk of dying from an arrhythmia. The finding of the high percentage of sudden deaths in this study indicates a need for further investigation into and wider utilization of current technology in the areas of transportation and care.

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APPENDIX A

APPENDIX A

Classification

Diagnostic Criteria of Chronic Rheumatic Heart Disease

The identification of a history of acute rheumatic fever (ARF) is helpful in making a diagnosis of CRHD (Hall, 1961 and 1970; Wallach et al., 1962).

Aortic Insufficiency. When the lesion is severe, it may be associated with the anginal syndrome. The diagnosis of aortic insufficiency should be made only in the presence of a characteristic murmur (The Criteria Committee of the New York Heart Association, 1964; Markowitz and Gordis, 1972). The minimal criteria for diagnosis of aortic insufficiency was suggested by Hall (1961).

Pulse. Large pulse pressure, with lowered diastolic and elevated systolic pressures.

Murmur. The diagnosis is made on the basis of the characteristic diastolic murmur, which is high-pitched, blowing in character and located in the left or right third intercostal space. A systolic murmur over the aorta may sometimes occur without being due to aortic stenosis.

X-ray. In advanced cases, roentgenography will often show an enlargement of the left ventricle.

ECG. Electrocardiography indicates left ventricular hypertrophy.

APPENDIX A -- Continued

Aortic Stenosis. It may be associated with the anginal syndrome. Attacks of syncope and sudden death may occur (The Criteria Committee of the New York Heart Association, 1964; Markowitz and Gordis, 1972). Aortic stenosis is usually seen in association with insufficiency of the aortic valves. The minimal criteria for diagnosis of stenosis was suggested by Hall (1961).

Blood Pressure and Pulse. Although the systolic blood pressure is low with a small pulse pressure, many exceptions occur.

Thrill and Murmur. The diagnosis is based mainly on a systolic thrill in the right second intercostal space - though not necessarily, and a systolic murmur, which is loudest in the right second intercostal space but which radiates over the entire thorax and up over the carotid arteries.

X-ray. Roentgenography will often reveal an enlargement of the left ventricle and sometimes calcification at the site of the aortic valves.

ECG. Electrocardiography indicates left ventricular hypertrophy.

Catheterization. Ventriculo-aortic gradient of systolic pressure across the aortic valve as determined by catheterization of the left heart.

Mitral Insufficiency. The minimal criteria for diagnosis of mitral insufficiency was suggested by Hall (1961).

Murmur. Mitral insufficiency is characterized by a pan-systolic murmur, best heard in the apical area and usually transmitted to the left axilla.

APPENDIX A -- Continued

X-ray. Roentgen examination will often reveal enlargement of left ventricle and atrium.

ECG. Electrocardiography often indicates left ventricular hypertrophy.

Catheterization. High V-wave with rapidly descending limb terminating in an early and consipicuous "Y." These may occur in the wedge pressure pulse or in the left atrial pressure pulse obtained by means of the cardiac catheter.

Mitral Stenosis. The underlying valvular deformity is most commonly caused by rheumatic fever (The Criteria Committee of the New York Heart Association, 1964; Markowitz and Gordis, 1972). The minimal criteria for diagnosis of mitral stenosis was suggested by Hall (1961).

Heart Sound and Murmur. The characteristic findings are a loud, snapping first sound and a split second sound with a low-pitched presystolic and/or early diastolic murmur often throughout diastole. The second sound over the pulmonary area is often accentuated.

X-ray. Roentgen examination usually shows an enlargement of the left atrium and in advanced cases, of the right ventricle and a dilatation of the pulmonary artery.

ECG. May show a right ventricular hypertrophy and large, notched P waves.

Tricuspid Insufficiency and Stenosis. The minimal criteria for the diagnosis was suggested by Hall (1961).

Cyanosis often combined with icterus; recurrent ascites; orthopnea is unusual and may be absent even with associated mitral stenosis; roentgenological examination shows enlargement of the right

APPENDIX A -- Continued

atrium and unexpectedly clear lung fields; right deviation of the axis of QRS is common with fibrillation of the atria.

Signs of Tricuspid Insufficiency. Systolic pulsation of the cervical veins, of the liver and sometimes of the veins of the extramities; a large V-wave in the right atrial pressure pulse, in the jugular phlebogram and in the hepatogram; systolic depression of the precordial area, in the presence of advanced tricuspid insufficiency, the lower half of the chest moves briskly from left to right in systole; a systolic murmur in the tricuspid area becoming louder during inspiration; the signs of tricuspid annular incompetency ("functional" insufficiency) are almost identical to those of organic tricuspid insufficiency, and differentiation of the two by signs alone is not possible.

Signs of Tricuspid Stenosis. Forceful, palpable, pre-systolic pulsation of the cervical veins, and a similar expansible pulsation of the liver; prominent A-wave and slow descent of the V-wave in the jugular phlebogram and in the right atrial pressure pulse; a presystolic or early diastolic rumble, louder during inspiration and snapping first sound audible well to the right of the sternum; a diastolic gradient of pressure across the tricuspid orifice.

Friedberg (1966) reported that, the most frequent occurrence of sudden death from RHD is in patients with aortic stenosis but it also occurs in children or adolescents with aortic regurgitation as well as in adults with this lesion.

Classification of Heart Disease

Ischemic Heart Disease (IHD). Included were the rubrics (410-

APPENDIX A -- Continued

414) in the Eighth Revision of International Classification of Disease (ICD), (USPHS, International Standard Classification of Disease, 1968), for the period of 1968, 1969 and 1970 of this study.

410 - Acute myocardial infarction.

411 - Other acute and subacute forms of IHD.

412 - Chronic IHD.

413 - Angina pectoris.

414 - Asymptomatic IHD.

For the study of IHD during the previous two years, 1966 and 1967, the Seventh Revision of ICD was used. The rubrics in the Seventh Revision of ICD were:

420 - 422 for Arteriosclerotic and Degenerative Heart Disease as follow:

420 - Arteriosclerotic heart disease (ASHD).

421 - Chronic endocarditis not specified as rheumatic.

422 - Other myocardial degeneration.

Hypertensive Heart Disease. Included were some of the rubrics (400-404) in the Eighth Revision of ICD for the period of 1968, 1969 and 1970 of this study.

401 - Malignant hypertension with heart involvement.

402 - HHD.

404 - Hypertensive heart and renal disease.

For the study of HHD during the earlier two years 1966 and 1967, the Seventh Revision of ICD was used.

440 - Essential benign HHD.

APPENDIX A -- Continued

441 - Essential malignant HHD.

442 - Hypertensive heart disease with arterioral nephrosclerosis.

443 - Other and unspecified HHD.

Chronic Rheumatic Heart Disease (CRHD). This included the rubrics (393-398) in the Eighth Revision of ICD for the period of 1968, 1969 and 1970.

393 - Disease of pericardium.

394 - Disease of mitral valve.

395 - Disease of aortic valve.

396 - Disease of mitral and aortic valves.

397 - Disease of other endocardial structure.

398 - Other heart disease, specified as rheumatic.

For the study of CRHD during 1966 and 1967 the Seventh Revision of ICD was used. CRHD in the Seventh Revision of ICD included (410-416) rubrics.

410 - Disease of mitral valve.

411 - Disease of aortic valve specified as rheumatic.

412 - Disease of tricuspid valve.

413 - Disease of pulmonary valve specified as rheumatic.

414 - Other endocarditis specified as rheumatic.

415 - Other myocarditis specified as rheumatic.

416 - Other heart disease specified as rheumatic.

Congenital Heart Disease. Included some of the rubrics (746-747) in the Eighth Revision of ICD for the period of 1968, 1969 and 1970.

APPENDIX A -- Continued

746 - Congenital anomalies of heart.

747 - Other congenital anomalies of circulatory system.

For the years 1966 and 1967, the Seventh Revision of ICD was used. Congenital heart disease in the Seventh Revision included some of the 754 rubrics.

Other Forms of Heart Disease. Included rubrics (420-429) in the Eighth Revision of ICD for years 1968, 1969 and 1970.

420 - Acute pericarditis, non-rheumatic.

421 - Acute and subacute endocarditis.

422 - Acute myocarditis.

423 - Chronic disease of pericardium, non-rheumatic.

424 - Chronic disease of endocardium.

425 - Cardiomyopathy.

426 - Pulmonary heart disease.

427 - Symptomatic heart disease.

428 - Other myocardial insufficiency.

429 - Ill-defined heart disease.

The Other Forms of Heart Disease. Included rubrics (430-434) in the Seventh Revision of ICD for the years 1966 and 1967.

430 - Acute and subacute endocarditis.

431 - Acute myocarditis not specified as rheumatic.

432 - Acute pericarditis.

433 - Functional disease of heart.

434 - Other and unspecified disease of heart.

APPENDIX A -- Continued

LETTER TO AMERICAN HEART ASSOCIATION, INC.

The University of Oklahoma Health
Sciences Center
Department of Community Health

August 16, 1971

American Heart Association, Inc.
44 East 23rd Street
New York, New York 10010

Attention: Executive Director

Dear

I am in the process of writing a protocol of my dissertation of Doctor of Philosophy degree in Community Health in the School of Health, University of Oklahoma. The title of my dissertation is "The Reliability of Heart Diseases Diagnosis on Death Certificate."

In order to find the reliability of heart diseases diagnosis I need to compare the medical record of the deceased with a standard criteria for diagnosis of heart diseases.

I would appreciate if you please send me the available publications of criteria especially on Ischemic Heart Disease, Hypertensive Heart Disease, Rheumatic Heart Disease, Congenital Heart Disease, and others. I have the book of "Diseases of the Heart and Blood Vessels" (Nomenclative and Criteria for Diagnosis) by the Criteria Committee of the New York Heart Association, Inc., and Jones Criteria for Guidance in the Diagnosis of Rheumatic Fever. In case if such publication reprints are not available, please send me the references at your earliest convenience.

Thanking you in advance.

Sincerely,

G. Reza Najem, M.D., M.P.H.
Special Instructor
Departments of Pediatrics
& Community Health

GRN/ln

OKLAHOMA STATE HEALTH DEPARTMENT

REQUEST FOR DATA

FROM CONFIDENTIAL RECORDS FOR RESEARCH PURPOSE

To Be Completed by Applicant in Triplicate

I. Type of Data Requested: Date: _____

a. ☐ List of certain confidential events (*describe) _____

_____

b. ☐ Copies of portions of confidential records (*describe) _____

_____

c. Access to ☐ Birth ☐ Death records dated between _____ (Date) and _____ (Date)

II. Attach Protocol of Research Proposal.

III. Assurance of Confidentiality:

If provided with the above requested information, it is agreed that the information will be used for the Research purpose as stated above and no information will be released to any other persons or agencies. In accordance with provisions of Oklahoma Statutes, I assure that the confidentiality of all information concerning identity of persons named in confidential records will be strictly maintained. All copies of portions of confidential records obtained will be returned on or before _____ (Date)

to the Office of Program Services, State Health Department, 3400 North Eastern, Oklahoma City 73105.

IV. a. _____
Signature of Applicant

b. _____
Title & Organization

c. _____
Address

V. APPROVAL:

a. _____ or,
Signature of Dean or Department Head

b. ☐ Individual reference attached

*Give complete description. If additional space is needed, please attach to this request.

To Be Completed By
OKLAHOMA STATE DEPARTMENT OF HEALTH

☐ Request can be granted without additional cost to State.

☐ Request would necessitate additional cost to State.

☐ Arrangements have been made for applicant to bear necessary costs.

☐ APPROVED ☐ DISAPPROVED

_____
Signature - Chief, Office of Program Services

_____
Date

_____
Supervisor's Signature

COMMENTS: _____

_____

Date: _____

☐ APPROVED ☐ DISAPPROVED

_____
Commissioner of Health

Date: _____

ODH No. VS 149

APPENDIX A -- Continued

LETTER TO NURSING HOMES

The University of Oklahoma Health
Sciences Center
Department of Community Health

May 17, 1972

Attention: Director

Nursing Home
Oklahoma City, Oklahoma

Dear

G. Reza Najem, M.D., is a student in the College of Health at the University of Oklahoma Health Sciences Center and is working toward a Ph.D. degree. His dissertation research revolves about the question of accuracy of "death certificate" diagnosis in the area of heart disease.

He already has surveyed the State Health Department files for the death certificate diagnosis and would like to now verify these with medical records in your nursing home. You may be assured that Dr. Najem is an M.D., and that the confidentiality of the patient record will be honored.

Therefore, this letter is to request permission for Dr. Najem to examine the medical record of the patients listed on the attached sheet.

Sincerely,

Thomas N. Lynn, Jr., M.D.
Chairman and Professor
Department of Community Health

TNL/lw
Enclosure:

APPENDIX A -- Continued

LETTER TO THE PHYSICIANS

The University of Oklahoma Health
Sciences Center
Department of Community Health

June 20, 1972

Dr.
Oklahoma City, Oklahoma

Dear Doctor:

G. Reza Najem, M.D., is a student in the College of Health at the University of Oklahoma Health Sciences Center and is working toward a Ph.D. degree. His dissertation research revolved about the question of "Reliability of Death Certificate Diagnosis" in the area of heart disease.

He already has surveyed the State Health Department files and most of the concerned hospitals and nursing homes records for death certificate diagnoses and would like to now verify some of these with medical records in your office. You may be assured that Dr. Najem is an M.D., and that the confidentiality of the patient record will be honored.

Therefore, this letter is to ask your cooperation in filling in the following forms as much as possible from the information available in your office records.

We would be grateful for your completing "Form I" and "Form II" and the form appropriate to your patients diagnosis; Form III, IV or V for each deceased. The name and cause of death on the death certificate of the deceased person and the date of expiration are indicated on Form I.

In the event you do not have time to complete these forms, Dr. Najem would be happy to do this if he is granted access to the patients record.

APPENDIX A -- Continued

LETTER TO THE PHYSICIANS - Continued

We are looking forward to hearing from you.

Sincerely,

Thomas N. Lynn, Jr., M.D.
Chairman and Professor
Department of Community Health

TNL/lw
Enclosure:

APPENDIX A -- Continued

LETTER TO HOSPITAL ADMINISTRATORS

The University of Oklahoma Health
Sciences Center
Department of Community Health

June 26, 1972

Hospital
Oklahoma City, Oklahoma

Attention: Administrator

Dear

G. Reza Najem, M.D., is a student in the College of Health at the University of Oklahoma Health Sciences Center and is working toward a Ph.D. degree. His dissertation research revolves about the question of accuracy of "death certificate" diagnosis in the area of heart disease.

He already has surveyed the State Health Department files for the death certificate diagnosis and would like to now verify these with medical records in your hospital. You may be assured that Dr. Najem is an M.D., and that the confidentiality of the patient record will be honored.

Therefore, this letter is to request permission for Dr. Najem to examine the medical record of the patients listed on the attached sheet.

Sincerely,

Thomas N. Lynn, Jr., M.D.
Chairman and Professor
Department of Community Health

TNL/cs
Enclosure:

APPENDIX A -- Continued

LETTER TO STATE MEDICAL EXAMINER

The University of Oklahoma Health
Sciences Center
Department of Community Health

July 27, 1972

824. N. E. 15th Street
Oklahoma City, Oklahoma

Attention: Chief Medical Examiner

Dear

G. Reza Najem, M. D., is a student in the College of Health at the University of Oklahoma Health Sciences Center and is working toward a Ph.D. degree. His dissertation research revolves about the question of "Reliability of Death Certificate Diagnosis" in the area of heart disease.

He already has surveyed the State Health Department files and most of the concerned hospitals, nursing homes, and physician's office records for death certificate diagnoses and would like to now verify some of these with medical records in your office. You may be assured that Dr. Najem is an M.D., and that the confidentiality of the patient record will be honored.

Therefore, this letter is to request permission for Dr. Najem to examine the medical records of the patients listed on the attached list of death certificates signed by Dr. Harry T. Cooper who was a medical examiner before he left for St. Louis.

Sincerely,

Thomas N. Lynn, Jr., M.D.
Chairman and Professor
Department of Community Health

TNL/cs
Enclosure:

APPENDIX A -- Continued

FORM I

QUESTIONNAIRE TO PHYSICIANS

DECEASED NAME: PLACE OF DEATH:
CAUSE OF DEATH ON DEATH CERTIFICATE: DATE EXPIRED:

1. IS THE ABOVE CAUSE OF DEATH THE SAME THAT YOU FOUND: ( ) YES ( ) No
   If "NO" please state your diagnosis of cause of death of the deceased:

   _____

2. FOR HOW LONG DID YOU TREAT THE DECEASED: ( )

3. WAS THE DEATH SUDDEN: ( ) YES ( ) NO

4. WERE YOU ATTENDING THE DECEASED AT THE TIME OF EXPIRATION: ( ) YES ( ) NO
   If "NO" was anybody else attending the deceased: ( ) YES ( ) NO

5. IF YOUR SOURCE OF INFORMATION IS ANOTHER PHYSICIAN, PLEASE STATE HIS NAME AND ADDRESS.

   _____

APPENDIX A -- Continued

FORM II

PERSONAL & FAMILY HISTORY

PLACE OF DEATH: ADMISSION DATE:_____
DR. NAME: DISCHARGE DATE:_____

NAME: _____ RACE: ( ) SEX: ( )
First Middle Last

BIRTHDATE: _____ AGE AT DEATH: ( )
Yr. Mo. Day

ADDRESS: _____ RELIGION: ( ) TEL: ( )

MARITAL STATUS: Single ( ) Married ( ) Divorced ( ) Separated ( )
Unknown ( )

RISK FACTORS:

OCCUPATION: _____ ACTIVE: ( ) STATIONARY: ( )

UNKNOWN: ( )

SMOKING HISTORY: EX-SMOKER ( ) SMOKER ( ) NON-SMOKER ( )

UNKNOWN ( )

HABITS OF ALCOHOL: CASUAL ( ) HABITUAL ( ) NON-DRINKER ( )

PAST HISTORY OF:

( ) HYPERTENSION ( ) OVERWEIGHT ( ) DIABETES

( ) ISCHEMIC HEART DIS. ( ) RENAL DIS. ( ) STROKE

OTHER DISORDERS: _____

_____

APPENDIX A -- Continued

FORM II - Continued

FAMILY HISTORY: (Mark X if any of the relatives have, had or died):

CONDITIONS	MOTHER	FATHER	SIBLINGS	CHILDREN	OTHER RELATIVES
Ischemic HD					
Hypertension					
Stroke					
Diabetes					
Overweight					
Specify Other					

APPENDIX A -- Continued

FORM III

CLINICAL INFORMATION

NAME: PLACE OF DEATH:
CHART #:

ISCHEMIC HEART DISEASE

CLINICAL MANIFESTATIONS:

Was anginal type pain present ( ) Type & Location of pain:_____
Pain brought by:_____ Radiation of pain to:_____
Duration of anginal pain:_____ Pain stopped by:_____
Number of previous attacks & dates:_____

( ) Nausea/vomiting	( ) Sweating	( ) Dyspnea
( ) Fatigability	( ) Palpitation	( ) Syncope
( ) Shock	( ) Pulmonary edema	( ) CHF
( ) Edema	( ) BP	( ) Pulse

Other signs & symptoms:_____

_____

BLOOD TEST FINDINGS: (record highest value)

( ) Cholesterol	( ) Triglycerides	( ) BUN
( ) Beta-lipoprotein	( ) SGOT	( ) SGPT
( ) LDH	( ) CPK	( ) Uric acid
( ) Glucose	( ) WBC	( ) Bhg.
( ) HCT	( ) ESR	( ) Anemia

Other Lab.findings: _____

_____

URINE ANALYSIS FINDINGS: _____

ECG FINDINGS: _____

RADIOGRAPHY FINDINGS: _____

SPECIAL STUDY FINDINGS AND CINEARTERIOGRAPHY:_____

FINAL DIAGNOSIS: _____

CAUSE OF DEATH: _____

AUTOPSY DIAGNOSIS: _____

APPENDIX A -- Continued

FORM IV

CLINICAL INFORMATION

NAME: PLACE OF DEATH:
CHART #:

HYPERTENSIVE HEART DISEASE

CLINICAL MANIFESTATIONS:

( ) History of hypertension	( ) Dizziness/drowsiness	( ) Nausea/ vomiting
( ) Headache	( ) Dyspnea	( ) Coma
( ) Highest BP syst./diast.	( ) Pulse	( ) Bleeding disorder
( ) Edema	( ) Renal involvemant	( ) CHF

Other Clinical Manifestation: _____

LABORATORY FINDINGS: (record highest value)

BLOOD:

( ) Anemia ( ) BUN ( ) Creatinin ( ) NA ( ) K ( ) pCO_2 ( ) pO_2

Other findings: _____

URINE ANALYSIS FINDINGS: _____

Other Lab.Findings: _____

RADIOGRAPHY FINDINGS: _____

ECG FINDINGS: _____

SPECIAL STUDIES FINDINGS AND OPHTALMOSCOPY: _____

FINAL DIAGNOSIS: _____

CAUSE OF DEATH: _____

AUTOPSY DIAGNOSIS: _____

APPENDIX A -- Continued

FORM V

CLINICAL INFORMATION

NAME: PLACE OF DEATH:
CHART #:

CHRONIC RHEUMATIC HEART DISEASE

PAST HISTORY OF: Rheumatic Fever ( ) Rheumatic Heart Dis. ( )

CLINICAL MANIFESTATIONS:
MURMURS: Specify each murmur characteristics including timing, location, transmission, grade, and so on: _____

_____

Describe characteristics of Thrill, Snap: 1st, 2nd, 3rd heart sound and pulsations: _____

_____

( ) Rumbles ( ) BP ( ) Pulse ( ) Arthritis
( ) Cyanosis ( ) Dyspnea ( ) Edema ( ) CHF
Other Clinical Manifestations: _____

RADIOGRAPHY FINDINGS: _____

ECG FINDINGS: _____

CATHETERIZATION INTERPRETATIONS: _____

OTHER SPECIAL STUDY FINDINGS: _____

LABORATORY FINDINGS: (record highest value):
( ) ANEMIA SED.RATE:_____ C-REACTIVE:_____ ASO:_____
URIC ACID:_____ SGOT:_____ SGPT:_____ LDH:_____
CPK:_____
Other Lab. Findings:_____

FINAL DIAGNOSIS: _____

CAUSE OF DEATH: _____

AUTOPSY DIAGNOSIS: _____

APPENDIX A -- Continued

TABLE I

SUMMARY OF CLASSIFICATION OF QUALITY OF SUPPORTING DIAGNOSTIC INFORMATION

Quality of Diagnosis	Ischemic Heart Disease	Hypertensive Heart Disease	Chronic Rheumatic Heart Disease
Definite	Autopsy or combination of at least two of the following items; typical history of anginal pain, typical ECG and typical lab. findings.	Autopsy or combination of history of hypertension and left ventricular hypertrophy (LVH).	Autopsy or combination of at least two of the following items; history of rh.fever, typical clinical picture (heart murmur) definite ECG findings.
Possible	Suggestive history of anginal pain or suggestive ECG findings	Combination of history of hypertension with suggestive LVH or suggestive cardiac involvement.	History of rh. fever and suggestive clinical or ECG findings.
Doubtful	No detailed support of clinical diagnosis.	No detailed support of clinical diagnosis.	No detailed support of clinical diagnosis.
Wrong	Patient died of some other diseases and by mistake was certified or was coded under IHD.	Patient died of some other diseases and by mistake was certified or was coded under HHD.	Patient died of some other diseases and by mistake was certified or coded under CRHD.
Sudden Death	Include DOA, SD, and VFD (Victim Found Dead).	Includes DOA, SD, & VFD	Includes DOA, SD, & VFD.

APPENDIX A -- Continued

TABLE II

CHARACTERISTICS OF THE NINE MISSING CASES

Case No.	Race	Sex	Age	Marital Status	Cause of Death	Approx. interval between onset & death	Place of Death	Date of Death
Ischemic Heart Disease								
1.	Caucasian (C)	Female (F)	79	Married (M)	a. Coronary Occlusion b. HHD	a. NA[a] b. for years	Home	2/3/70
2.	C	Male (M)	68	M	a. Extensive Anterolateral Myocardial Infarction	NA[a]	South Community Hospital	9/12/70
3.	C	F	81	Widow (W)	a. Acute Coronary Thrombosis b. Thrombosis, old & new c. ASHD	NA[a]	Capital Hill Nursing Home (NH)	5/15/70
4.	C	F	57	Single	a. Congestive Heart Failure b. General Carcinoma	a. 1 wk b. 8 yrs.	Mercy Hospital	10/12/70

APPENDIX A -- Continued

TABLE II - Continued

CHARACTERISTICS OF THE NINE MISSING CASES

Case No.	Race	Sex	Age	Marital Status	Cause of Death	Approx. interval between onset & death	Place of Death	Date of Death
Ischemic Heart Disease								
5.	C	M	82	M	a. ASHD b. Arteriosclerosis, generalized c. Old age	a. 18 yrs. b. years	Capital Hill N.H.	12/14/70
6.	C	F	91	W	a. Cardiac arrest b. ASHD c. Anemia, senility	NA[a]	Lahoma Rehab. Home	3/14/70
7.	C	F	87	W	a. CVA b. Myoc.Infarction c. Pneumonia & CHF	a. 48 hrs. b. unknown c. NA[a]	South Community Hospital	7/1/70

APPENDIX A -- Continued

TABLE II - Continued

CHARACTERISTICS OF THE NINE MISSING CASES

Case No.	Race	Sex	Age	Marital Status	Cause of Death	Approx. interval between onset & death	Place of Death	Date of Death
Hypertensive Heart Disease								
1.	C	F	91	W	a. Cardiac failure b. Senility, Hypertension & Arteriosclerosis	a. 3 days b. 2 yrs.	Lou Len N.H.	1/31/70
Chronic Rheumatic Heart Disease								
1.	C	M	55	M	a. Cardiac Arrhythmia b. RHD	a. 5 min. b. Unknown	Home	8/26/69

[a]NA = Not available.

APPENDIX A -- Continued

TABLE III

DESCRIPTION OF STUDY GROUP

Characteristics	Ischemic HD[a]		Hypertensive HD		Chr.Rheumatic HD		Total	
	No.	%	No.	%	No.	%	No.	%
Race								
Caucasian	83	89.2	25	62.5	15	88.2	123	82.0
Negro	10	10.8	15	37.5	2	11.8	27	18.0
Indian	0	0	0	0	0	0	0	0
Total	93	100.0	40	100.0	17	100.0	150	100.0
Sex								
Male	49	52.7	27	67.5	11	64.7	87	58.0
Female	44	47.3	13	32.5	6	35.3	63	42.0
Age								
Under 40	2	2.2	0	0	0	0	2	1.3
40 - 49	6	6.5	2	5.0	3	17.6	11	7.4
50 - 59	8	8.6	2	5.0	2	11.8	12	8.0
60 - 69	25	26.9	6	15.0	7	41.2	38	25.3
70 - 79	26	28.0	15	37.5	4	23.5	45	30.0
80 - 89	24	25.8	13	32.5	1	5.9	38	25.3
90 & over	2	2.2	2	5.0	0	0	4	2.7
Place of Death								
Hospital	59	63.4	27	67.5	17	100.0	103	68.7
N & C[b] Home	10	10.8	5	12.5	0	0	15	10.0
Not in Hosp. or Inst.[c]	24	25.8	8	20.0	0	0	32	21.3

[a] Heart Disease
[b] Nursing and Convalescent
[c] Hospital or Institution

APPENDIX B

APPENDIX B

TABLE I

THE RELIABILITY OF ISCHEMIC HEART DISEASE DIAGNOSIS ON THE DEATH CERTIFICATES BY AGE, OKLAHOMA CITY SAMPLE, 1970

Age	Definite	Possible	Doubtful	Wrong	SD[a]	Total	%
Under 40	0	1 (50.0)[b]	0	0	1 (50.0)	2 (100.0)	2.1
40 - 49	3 (50.0)	0	0	0	3 (50.0)	6 (100.0)	6.4
50 - 59	1 (12.5)	1 (12.5)	1 (12.5)	0	5 (62.5)	8 (100.0)	8.6
60 - 69	3 (12.0)	4 (16.0)	5 (20.0)	2 (8.0)	11 (44.0)	25 (100.0)	26.9
70 - 79	2 (7.7)	5 (19.2)	6 (23.1)	0	13 (50.0)	26 (100.0)	28.0
80 - 89	2 (8.3)	2 (8.3)	7 (29.2)	2 (8.3)	11 (45.9)	24 (100.0)	25.8
90+ over	0	0	2 (100.0)	0	0	2 (100.0)	2.2

[a]Sudden Death.
[b]Numbers in parentheses are per cent of total of each row.

APPENDIX B -- Continued

TABLE II

THE RELIABILITY OF HYPERTENSIVE HEART DISEASE DIAGNOSIS ON THE DEATH CERTIFICATES BY AGE, OKLAHOMA CITY, 1969 and 1970

Age	Definite	Possible	Doubtful	Wrong	SD[a]	Total	%
Under 50	2 (100.0)[b]	0	0	0	0	2 (100.0)	5.0
50 - 59	0	0	1 (50.0)	0	1 (50.0)	2 (100.0)	5.0
60 - 69	2 (33.3)	1 (16.7)	2 (33.3)	1 (16.7)	0	6 (100.0)	15.0
70 - 79	3 (20.0)	5 (33.3)	2 (13.3)	3 (20.0)	2 (13.3)	15 (100.0)	37.5
80 - 89	2 (15.4)	2 (15.4)	4 (30.8)	4 (30.8)	1 (7.6)	13 (100.0)	32.5
90+ over	0	0	1 (50.0)	1 (50.0)	0	2 (100.0)	5.0

[a] Sudden Death.
[b] Numbers in parentheses are percents of total of each row.

APPENDIX B -- Continued

TABLE III

THE RELIABILITY OF CHRONIC RHEUMATIC HEART DISEASE DIAGNOSIS ON THE DEATH CERTIFICATES BY AGE, OKLAHOMA CITY 1969 and 1970

Age	Definite	Possible	Doubtful	Wrong	SD[a]	Total	%
Under 50	1 (33.3)	0	1 (33.3)[b]	0	1 (33.3)	3 (100.0)	17.6
50 - 59	2 (100.0)	0	0	0	0	2 (100.0)	11.8
60 - 69	2 (28.6)	0	3 (42.8)	0	2 (28.6)	7 (100.0)	41.2
70 - 79	2 (50.0)	2 (50.0)	0	0	0	4 (100.0)	23.5
80 - 89	0	1 (100.0)	0	0	0	1 (100.0)	5.9

[a] Sudden Death.
[b] Numbers in parentheses are the per cent of total of each row.

APPENDIX B -- Continued

TABLE IV

THE RELIABILITY OF ISCHEMIC HEART DISEASE DIAGNOSIS ON DEATH CERTIFICATES BY MARITAL STATUS, OKLAHOMA CITY, 1970

Reliability of Diagnosis	Married	Divorced	Separated	Widowed	Single
Definite	6 (11.1)[a]	1 (20.0)	0	2 (7.4)	2 (50.0)
Possible	9 (16.7)	0	0	4 (14.8)	0
Doubtful[b]	10 (18.5)	2 (40.0)	0	7 (25.9)	1 (25.0)
Wrong	3 (5.6)	0	0	1 (3.7)	0
Sudden Death	26 (48.1)	2 (40.0)	2 (100.0)	13 (48.2)	1 (25.0)
Total	54 (100.0)	5 (100.0)	2 (100.0)	27 (100.0)	4 (100.0)
Per cent	58.7	5.4	2.2	29.3	4.4

[a]Numbers in parentheses are per cent of total of each column.
[b]One unknown marital status is not included.

APPENDIX B -- Continued

TABLE V

THE RELIABILITY OF HYPERTENSIVE HEART DISEASE DIAGNOSIS ON DEATH CERTIFICATES BY MARITAL STATUS, OKLAHOMA CITY, 1969 and 1970

Reliability of Diagnosis	Married	Divorced	Separated	Widowed	Single
Definite	8 (34.8)[a]	0	0	0	1 (20.0)
Possible	4 (17.4)	1 (50.0)	0	1 (50.0)	2 (40.0)
Doubtful	5 (21.7)	0	0	5 (50.0)	0
Wrong	5 (21.7)	0	0	3 (30.0)	1 (20.0)
Sudden Death	1 (4.4)	1 (50.0)	0	1 (10.0)	1 (20.0)
Total	23 (100.0)	2 (100.0)	0	10 (100.0)	5 (100.0)
Per cent	57.5	2.5		27.5	12.5

[a]Numbers in parentheses are per cent of total of each column.

APPENDIX B -- Continued

TABLE VI

THE RELIABILITY OF CHRONIC RHEUMATIC HEART DISEASE DIAGNOSIS ON DEATH CERTIFICATES BY MARITAL STATUS, OKLAHOMA CITY, 1969 and 1970

Reliability of Diagnosis	Married	Divorced	Separated	Widowed	Single
Definite	4 (36.4)[a]	0	0	3 (75.0)	0
Possible	2 (18.2)	0	0	0	0
Doubtful	4 (36.3)	0	0	0	0
Wrong	0	0	0	0	0
Sudden Death	1 (9.1)	0	0	1 (25.0)	1 (50.0)
Total	11 (100.0)	0	0	4 (100.0)	2 (100.0)

[a]Numbers in parentheses are per cent of total of each column.

APPENDIX B -- Continued

TABLE VII

ARTERIOSCLEROTIC AND DEGENERATIVE HEART DISEASE MORTALITY BY CAUSE AND YEAR, OKLAHOMA COUNTY, 1966-1967

Cause of Death	1966	1967	Total
ASHD[a] including Coronary Disease	1,050 (92.9)[b]	1,076 (95.0)	2,126 (93.9)
Chronic Endocarditis not specified as Rheumatic	11 (1.0)	7 (0.6)	18 (0.8)
Other Myocardial Degeneration	69 (6.1)	50 (4.4)	119 (5.3)
Total	1,130 (100.0)	1,133 (100.0)	2,263 (100.0)

[a] Arteriosclerotic Heart Disease
[b] Numbers in parentheses are per cent of total of each column.

APPENDIX B -- Continued

TABLE VIII

ISCHEMIC HEART DISEASE (IHD) MORTALITY BY CAUSE AND YEAR, OKLAHOMA COUNTY, 1968-1970

Cause of Death	1968	1969	1970	Total
Acute Myocardial Infarction	895 (66.8)[a]	875 (63.6)	900 (64.2)	2,670 (64.9)
Unspecified Acute and subacute IHD	4 (0.3)	8 (0.6)	1 (0.1)	13 (0.3)
Chronic IHD	435 (32.5)	493 (35.8)	501 (35.7)	1,429 (34.7)
Angina Pectoris	5 (0.4)	0	0	5 (0.1)
Total	1,339 (100.0)	1,376 (100.0)	1,402 (100.0)	4,117 (100.0)

[a] Numbers in parenthese are per cent of total of each column.

APPENDIX B -- Continued

TABLE IX

HYPERTENSIVE HEART DISEASE (HHD) MORTALITY BY CAUSE AND YEAR
OKLAHOMA COUNTY, 1966-1967

Cause of Death	1966	1967	Total
Essential Malignant HHD	0	1 (2.0) [a]	1 (0.9)
HHD with Arteriolar Nephrosclerosis	20 (31.3)	14 (27.4)	34 (29.6)
Other & Unspecified HHD	44 (68.7)	36 (70.6)	80 (69.5)
Total	64 (100.0)	51 (100.0)	115 (100.0)

[a]Numbers in parentheses are per cent of total of each column.

APPENDIX B -- Continued

TABLE X

HYPERTENSIVE HEART DISEASE (HHD) MORTALITY BY CAUSE AND YEAR
OKLAHOMA COUNTY, 1968-1970

Cause of Death	1968	1969	1970	Total
Malignant Hypertension with Heart Involvement	0	0	1 (5.2)[a]	1 (1.5)
Hypertensive Heart Disease	12 (60.0)	17 (58.6)	9 (47.4)	38 (55.9)
Hypertensive Heart & Renal Disease	8 (40.0)	12 (41.4)	9 (47.4)	29 (42.6)
Total	20 (100.0)	29 (100.0)	19 (100.0)	68 (100.0)

[a]Numbers in parentheses are per cent of total of each column.

APPENDIX B -- Continued

TABLE XI

CHRONIC RHEUMATIC HEART DISEASE MORTALITY BY CAUSE AND YEAR
OKLAHOMA COUNTY, 1966-1967

Cause of Death	1966	1967	Total
Disease of Mitral Valve	3 (15.8)[a]	3 (25.0)	6 (19.4)
Disease of Aortic Valve	3 (15.8)	2 (16.7)	5 (16.1)
Endocarditis Specified as Rheumatic	1 (5.3)	0	1 (3.2)
Myocarditis Specified as Rheumatic	1 (5.3)	1 (5.3)	2 (6.4)
Other Heart Disease Specified as Rheumatic	11 (57.8)	6 (50.0)	17 (54.9)
Total	19 (100.0)	12 (100.0)	31 (100.0)

[a]Numbers in parentheses are percents of total of each column.

APPENDIX B -- Continued

TABLE XII

CHRONIC RHEUMATIC HEART DISEASE MORTALITY BY CAUSE AND YEAR, OKLAHOMA COUNTY, 1968-1970

Cause of Death	1968	1969	1970	Total
Disease of Mitral Valve	4 (21.1)[a]	3 (17.6)	2 (12.5)	9 (17.3)
Disease of Aortic Valve	2 (10.5)	8 (47.1)	4 (25.0)	14 (26.9)
Disease of Mitral and Aortic Valves	2 (10.5)	0	3 (18.8)	5 (9.6)
Disease of Other Endocardial Structures	11 (57.9)	6 (35.3)	7 (43.7)	24 (46.2)
Total	19 (100.0)	17 (100.0)	16 (100.0)	52 (100.0)

[a] Numbers in parentheses are per cent of total of each column.

APPENDIX B -- Continued

TABLE XIII

CONGENITAL HEART DISEASE MORTALITY BY CAUSE AND YEAR
OKLAHOMA COUNTY, 1966-1967

Cause of Death	1966	1967	Total
Tetralogy of Fallot	1 (3.8)[a]	1 (5.3)	2 (4.4)
Patent Ductus Arteriosus	2 (7.7)	2 (10.5)	4 (8.9)
Ventricular Septal Defect	4 (15.4)	0	4 (8.9)
Other Unspecified Malformation of Heart	16 (61.5)	12 (63.2)	28 (62.3)
Other Circulatory Malformation	3 (11.6)	4 (21.0)	7 (15.5)
Total	26 (100.0)	19 (100.0)	45 (100.0)

[a]Numbers in parentheses are per cent of total of each column.

APPENDIX B -- Continued

TABLE XIV

CONGENITAL HEART DISEASE MORTALITY BY CAUSE AND YEAR, OKLAHOMA COUNTY, 1968-1970

Cause of Death	1968	1969	1970	Total
Total Congenital Anomalies of Heart:	20 (83.3)[a]	14 (93.3)	8 (88.9)	42 (87.5)
Transposition of Great Vessels	2 (8.3)	2 (13.3)	1 (11.1)	5 (10.4)
Tetralogy of Fallot	0	2 (13.3)	0	2 (4.2)
Ventricular Septal Defect	0	1 (6.7)	0	1 (2.1)
Atrial Septal Defect	0	0	1 (11.1)	1 (2.1)
Ostium Atrioventricular Commune	0	0	1 (11.1)	1 (2.1)
Anomalies of Heart Valves	1 (4.2)	2 (13.3)	1 (11.1)	4 (8.3)
Other Specified Anomalies of Heart	4 (16.7)	1 (6.7)	0	5 (10.4)
Unspecified Anomalies of Heart	13 (54.1)	6 (40.0)	4 (44.5)	23 (47.9)
Total Other Congenital Anomalies of Circulatory System:	4 (16.7)	1 (6.7)	1 (11.1)	6 (12.5)

APPENDIX B -- Continued

TABLE XIV - Continued

CONGENITAL HEART DISEASE MORTALITY BY CAUSE AND YEAR, OKLAHOMA COUNTY, 1968-1970

Cause of Death	1968	1969	1970	Total
Patent Ductus Arterious	3 (12.5)[a]	0	0	3 (6.2)
Other Anomalies of Aorta	0	0	1 (11.1)	1 (2.1)
Stenosis or Atresia of Pulmonary Artery	0	1 (6.7)	0	1 (2.1)
Unspecified Anomalies of Circulatory System	1 (4.2)	0	0	1 (2.1)
GRAND TOTAL	24 (100.0)	15 (100.0)	9 (100.0)	48 (100.0)

[a] Numbers in parentheses are per cent of total of each column.

APPENDIX B -- Continued

TABLE XV

MORTALITY OF OTHER FORMS OF HEART DISEASE BY CAUSE AND YEAR, OKLAHOMA COUNTY, 1966-1967

Cause of Death	1966	1967	Total
Acute and Subacute Endocarditis	1 (1.1)[a]	1 (0.9)	2 (1.0)
Total Functional Disease of Heart:	30 (32.3)	30 (28.6)	60 (30.3)
Heart Block	12 (12.9)	13 (12.4)	25 (12.6)
Other Disorders of Heart Rhythm	18 (19.4)	17 (16.2)	35 (17.7)
Total Other & Unspecified Disease of Heart:	62 (66.6)	74 (70.5)	136 (68.7)
Congestive Heart Failure	37 (39.8)	38 (36.3)	75 (37.9)
Left Ventricular Failure	0	1 (0.9)	1 (0.5)
Other Disease of Heart	1 (1.1)	0	1 (0.5)
Unspecified Disease of Heart	24 (25.7)	35 (33.3)	59 (29.8)
GRAND TOTAL	93 (100.0)	105 (100.0)	198 (100.0)

[a]Numbers in parentheses are perc cent of total of each column.

APPENDIX B -- Continued

TABLE XVI

MORTALITY OF OTHER FORMS OF HEART DISEASE BY CAUSE AND YEAR, OKLAHOMA COUNTY, 1968-1970

Cause of Death	1968	1969	1970	Total
Acute Pericarditis	1 (1.1)[a]	0	0	1 (0.4)
Acute & Subacute Endocarditis	2 (2.3)	1 (1.4)	2 (2.5)	5 (2.1)
Acute Myocarditis	3 (3.3)	2 (2.9)	3 (3.8)	8 (3.3)
Chronic Disease of Pericardium, non-rheumatic	1 (1.1)	2 (2.9)	1 (1.3)	4 (1.7)
Chronic Disease of Endocardium	3 (3.3)	1 (1.4)	2 (2.5)	6 (2.5)
Cardiomyopathy	0	2 (2.9)	3 (3.8)	5 (2.1)
Pulmonary Heart Disease	0	1 (1.4)	2 (2.5)	3 (1.3)
Total Symptomatic Heart Disease:	80 (88.9)	61 (87.1)	66 (83.6)	207 (86.6)
Congestive Heart Failure	30 (33.3)	24 (34.3)	26 (32.9)	80 (33.5)
Left Ventricular Failure	1 (1.1)	0	0	1 (0.4)
Cardiac Arrest	8 (8.9)	15 (21.4)	19 (24.2)	42 (17.5)

APPENDIX B -- Continued

TABLE XVI-Continued

MORTALITY OF OTHER FORMS OF HEART DISEASE BY CAUSE AND YEAR, OKLAHOMA COUNTY, 1968-1970

Cause of Death	1968	1969	1970	Total
Other Heart Block	1 (1.1)[a]	1 (1.4)	0	2 (0.8)
Atrial Fibrillation or Flutter	3 (3.3)	0	1 (1.3)	4 (1.7)
Ventricular Fibrillation or Flutter	3 (3.3)	3 (4.3)	5 (6.3)	11 (4.6)
Other Myocardial Insufficiency	11 (12.2)	3 (4.3)	8 (10.1)	22 (9.2)
Ill-defined Heart Disease	3 (3.3)	1 (1.4)	0	4 (1.7)
Other & Unspecified Heart Disease	20 (22.2)	12 (17.1)	5 (6.3)	37 (15.5)
GRAND TOTAL	90 (100.0)	70 (100.0)	79 (100.0)	239 (100.0)

[a] Numbers in parentheses are per cent of total of each column.

APPENDIX B -- Continued

TABLE XVII

SEX DISTRIBUTION OF DEATHS FROM HEART DISEASE, BY TYPE, OKLAHOMA COUNTY, 1966-1970

Heart Disease (HD)	Male	Female	Total
Ischemic HD	3,773 (59.1)[a]	2,607 (40.9)	6,380 (100.0)
Hypertensive HD	95 (51.9)	88 (48.1)	183 (100.0)
Chronic Rheumatic HD	31 (37.3)	52 (62.7)	83 (100.0)
Congenital HD	51 (54.8)	42 (45.2)	93 (100.0)
Other Forms of HD	251 (57.4)	186 (42.6)	437 (100.0)
Total	4,201 (58.5)	2,975 (41.2)	7,176 (100.0)

[a]Numbers in parentheses are per cent of total of each row.

APPENDIX B -- Continued

TABLE XVIII

THE AGE DISTRIBUTION OF DEATHS FROM HEART DISEASE, BY TYPE, OKLAHOMA COUNTY, 1966-1970

Age	Ischemic HD[a]	Hypertensive HD	Chronic Rheumatic HD	Congenital HD	Other Forms of HD	Total	%
Under 5	0	0	0	69	8	77	1.1
5 - 9	1	0	0	2	1	4	0.05
10 - 14	0	0	0	1	2	3	0.04
15 - 19	2	0	0	2	7	11	0.2
20 - 24	1	0	2	2	3	8	0.1
25 - 29	3	0	2	2	2	9	0.1
30 - 34	14	1	2	2	3	22	0.3
35 - 39	57	0	5	1	9	72	1.0
40 - 44	116	3	6	1	6	132	1.8
45 - 49	228	6	8	1	19	262	3.6
50 - 54	284	7	8	3	23	325	4.5
55 - 59	472	5	10	3	28	518	7.2
60 - 64	700	11	9	1	44	765	10.7
65 - 69	792	15	14	0	42	863	12.0
70 - 74	922	32	6	1	42	1,003	14.0
75 - 79	927	42	6	0	65	1,040	14.5
80 - 84	901	20	5	0	51	977	13.6
85 - 89	569	27	0	0	49	645	10.0
90 & over	391	14	0	0	33	438	6.1

APPENDIX B -- Continued

TABLE XVIII - Continued

THE AGE DISTRIBUTION OF DEATHS FROM HEART DISEASE, BY TYPE, OKLAHOMA COUNTY, 1966-1970

Age	Ischemic HD	Hypertensive HD	Ghronic Rheumatic HD	Congenital HD	Other Forms of HD	Total	%
Unknown	0	0	0	2	0	2	0.01
Total	6,380	183	83	93	437	7,176	100.0

[a] Heart Disease.

APPENDIX B -- Continued

TABLE XIX

HEART DISEASE MORTALITY, BY AGE, OKLAHOMA COUNTY, 1970

Age	Death	Rate per 100,000
Under 5	10	22.5
5 - 9	0	0
10 - 14	0	0
15 - 19	4	8.4
20 - 24	3	6.8
25 - 29	0	0
30 - 34	2	6.3
35 - 39	16	52.2
40 - 44	24	73.6
45 - 49	57	172.2
50 - 54	53	194.9
55 - 59	111	457.9
60 - 64	157	737.0
65 - 69	195	1176.4
70 - 74	213	1736.8
75 - 79	208	2567.9
80 - 84	229	4656.4
85 & over	243	7187.2
Total	1,525	289.5

APPENDIX B -- Continued

TABLE XX

THE DISTRIBUTION OF DEATHS FROM HEART DISEASE BY PLACE OF DEATH, OKLAHOMA COUNTY, 1966 - 1970

Heart Disease (HD)	Hospitals	Nursing Homes	Doctor's Clinics	Not in Hospital or Institution	Total
Ischemic HD	3,243 (50.8)[a]	834 (13.1)	8 (0.1)	2,295 (36.0)	6,380 (100.0)
Hypertensive HD	104 (56.8)	34 (18.6)	4 (2.2)	41 (22.4)	183 (100.0)
Chronic Rheumatic HD	66 (79.6)	2 (2.4)	0	15 (18.1)	83 (100.0)
Congenital HD	83 (89.2)	1 (1.1)	0	9 (9.7)	93 (100.0)
Other Forms of HD	234 (53.5)	79 (18.1)	0	124 (28.4)	437 (100.0)
Total	3,730 (52.0)	950 (13.2)	12 (0.2)	2,484 (34.6)	7,176 (100.0)

[a] Numbers in parentheses are per cent of total of each row.