A study of the effectiveness of AN-DRGs in classification of acute admitted patients with diabetes diagnoses

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Abstract

The Australian National Diagnosis Related Groups (AN-DRG) classification is intended to assign acute inpatient episodes to classes which are relatively homogeneous in terms of clinical attributes and the resources used in the provision of care. The purpose of this study was to determine the extent to which this objective was met in a sample of acute admitted patients with one or more diagnoses indicating the presence of diabetes mellitus.

The sample comprised all 2094 discharges with one or more diabetes diagnoses from acute care hospitals in the Illawarra Area Health Service in 1993-94. A subsample of 386 records was selected for the purpose of more detailed analysis by chart audit. Finally, another sample of 22 admitted patients was identified who were known to have diabetes because of their contacts with a community service, but whose diabetes had not been recorded in the discharge database.

There were three major findings. First, the discharges were distributed among many AN-DRGs in a way which was neither clinically coherent nor effective in terms of prediction of resource use. The logic of AN-DRG assignment, while effective for many types of care needs, appears to be less so where there is an underlying chronic condition. Compromises are unavoidable, but there is reason to conclude that chronic conditions have been given too little attention.

Second, there were many weaknesses in the data which are routinely assembled for the purpose of AN-DRG assignment. They included errors of medical documentation, abstraction and sequencing, and coding.

Third, the AN-DRG logic appears to ignore or under-estimate the effects of diabetes as a secondary condition. One critical finding which supports this view was that, where all diabetes diagnoses were deleted and the records re-assigned to AN-DRGs, only 10 records in 1945 (0.5%) were assigned to different classes. Diabetes diagnoses have so little effect for one dominant reason: that the DRG logic only takes account of one more diagnosis after the principal, and a condition like diabetes is characterised by multiple problems.

It is concluded that, if the AN-DRG classification is to become more effective for cases with serious chronic conditions like diabetes, modifications will be needed in the simple and near-universal logic of assignment to a diagnosis or procedure cluster followed by (selective) splitting on one more condition and/or age. Some preliminary ideas are presented as to how greater precision and clinical meaning might be achieved.

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Glossary of acronyms

ACCC	Australian Casemix Clinical Committee
ALOS	Average length of stay
AN-DRG	Australian National Diagnosis Related Groups
BGL	Blood Glucose Level
CCs	Complications and Comorbidities
CCF	Complicating Clinical Factor
CMG	Case Mix Groups
DEIU	Diabetes Education and Information Unit
DRG	Diagnosis Related Group
EDCG	Endocrine and Diabetes Clinical Group
HCFA	Health Care Financing Administration
HRG	Healthcare Resource Group
HIMAA	Health Information Management Association of Australia
IAHS	Illawarra Area Health Service
IRH	Illawarra Regional Hospital
ICD-9-CM	International Classification of Diseases, 9th Edition, Clinical Modification
IDDM	Insulin Dependent Diabetes Mellitus
LOS	Length of Stay
MDC	Major Diagnostic Group
NCC	National Coding Centre
NIDDM	Non Insulin Dependent Diabetes Mellitus
PDX	Principal Diagnosis
PPS	Prospective Payment System
RIV	Reduction in Variance
SDX	Secondary Diagnosis
TRG	Technical Reference Group

Definitions of terms

⊗ Average Length of Stay (ALOS)

The mean length of stay for a group of patients (National Health Data Committee 1995:2-4).

⊗ Length of Stay (LOS)

The period of hospitalisation for an individual patient.

⊗ Acute Admitted inpatient

An inpatient whose illness is acute, and has one or more problems which require short-term health care in an inpatient setting. Now termed the acute admitted patient.

⊗ Admission

The administrative process which begins an episode of care. Also used to refer to the start of an episode of hospitalisation.

⊗ Comorbidity

A secondary condition existing at the time of admission which, because of its presence with a specific principal diagnosis, causes an increase in length of stay. In the AN-DRG classification, a comorbidity is expected to result in an increased length of stay of at least one day in 75% of patients. (Eagar & Hindle 1994b:12).

⊗ Complication

A secondary condition arising during the hospital stay which, when present in association with one or more specific diagnosis, causes an increase in length of stay. (Eagar & Hindle 1994b:12).

⊗ Principal Diagnosis (PDX)

That diagnosis or condition established after study to be chiefly responsible for occasioning the patient's admission to hospital. (National Health Data Committee 1995:3-83).

⊗ Principal Procedure

The most significant procedure that was performed for treatment of the principal diagnosis. (National Health Data Committee, 1995:3-89).

⊗ Secondary Diagnosis (SDX)

Any condition additional to the principal diagnosis which affects patient care by requiring clinical evaluation, therapeutic treatment, diagnostic procedures, extended length of stay, or increased nursing care or monitoring. Includes complications and comorbidities. (Eagar & Hindle, 1994b:39).

⊗ Cost weight

A measure of the average cost of an AN-DRG, compared with the average cost of a reference AN-DRG. Usually the average cost across all AN-DRGs is chosen as the reference value, and given a weight of 1. (Eagar & Hindle 1994b:6).

⊗ Insulin Dependent Diabetes Mellitus (IDDM)

A type of diabetes that most commonly occurs in people aged less than 35 years and is characterised by an absolute failure of the pancreas to produce insulin. The disorder is characterised by sudden onset of symptoms which include frequent urination, thirst, hunger and blurred vision. Untreated the condition can progress to ketoacidosis and death. People with IDDM depend upon insulin injections to sustain life (Dunning 1994).

⊗ Iso-Resource Group

All cases within the group cost approximately the same to treat.

⊗ Non Insulin Dependent Diabetes Mellitus (NIDDM)

A type of diabetes that most commonly occurs in people over the age of 35 years. NIDDM differs from IDDM in that the slow onset means that people can have NIDDM for several years before the condition is diagnosed.

People with NIDDM often produce adequate quantities of insulin, however because the body becomes resistant to the insulin that is produced, it is not effective. Treatment requires diet and exercise which may be supplemented by oral hypoglycaemic therapy (tablets) and/or insulin. An estimated 40% of people with NIDDM use insulin to improve control and are termed insulin requiring (Dunning 1994).

⊗ Outlier

A discharge that is outside of the normal distribution which describes the majority of cases within an AN-DRG. Removal of outliers from aggregate data results in more reliable comparisons of the frequency distribution of the remaining data (Reid 1991:7).

⊗ Australian Casemix Clinical Committee (ACCC)

A body formed in 1991 to provide clinical input to casemix issues, and particularly development of the AN-DRG classification.

⊗ International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM)

A modification of the international standard classification of diagnoses and procedures (ICD-9), which is maintained by the US government. It has been clinically modified for morbidity coding, and especially for use in acute care.

⊗ Major Diagnostic Categories (MDCs)

A high level of grouping of patients according to principal diagnoses, use in the Diagnosis Related Groups (DRG) casemix classification. The Australian National DRG variant has 23 Major Diagnostic Categories.

⊗ Trimming

The process of removal of unusual cases prior to production of statistics. For example, analysis of trimmed DRG data would involve prior removal of (say) patients who were in hospital for unusually short or long periods.

⊗ Trim point

The value of a variable above or below which patient care episodes may be trimmed.

⊗ Variance explained, reduction in variance (RIV)

In the classification design context, the proportion of total variance which is between (rather than within) classes. A measure of the effectiveness of the classification. Also know by the statistic R^2 (the coefficient of multiple determination).

CHAPTER 1

AN OVERVIEW OF CLASSIFICATION AND CASEMIX

AIMS OF THE STUDY

ORGANISATION OF THE THESIS

CASEMIX AND THE CLASSIFICATION OF HEALTH CARE PRODUCTS

A BRIEF HISTORY OF DIAGNOSIS RELATED GROUPS

DATA REQUIREMENTS FOR DRG ASSIGNMENT

AN-DRG ASSIGNMENT LOGIC

DRGs AND RESOURCE ALLOCATION

Chapter 1 An overview of classification and casemix

Health professionals have always classified patients and the care they receive according to observable characteristics. However, the classifications were not always efficiently designed or suited to the analytical tasks to which they were applied.

The interest in classification has increased in recent years, largely as a consequence of four factors. First, it is now possible to apply computer technology for the purpose of evaluation of large numbers of optional structures. Second, many more data are available on computer media to support analysis. Third, there is a better understanding of the practice of health care management (as opposed to clinical and epidemiological research) and of the ways in which classifications are relevant. Finally, the requirements for use of information in health planning, policy, and finance have increased.

Casemix is a set of ideas about how to create better classifications of patient care episodes, and how they may be used (Eagar & Hindle 1994a). A key idea is that, although class boundaries are defined according to clinical attributes, it is necessary also to ensure each class is distinctive in terms of some other variable of global interest, such as cost, quality of care, prognosis, outcome, or utility. Most attention has been paid to resource-use homogeneity, and hence to iso-resource classifications. However, iso-utility classification has been the focus in some circumstances, including Oregon's Medicaid funding model (Brannigan 1993; Fox & Leichter 1991).

The most widely known casemix classification is Diagnosis Related Groups (DRGs). It was developed by a team under Professor Fetter at Yale University in the early 1970s as an iso-resource classification (Fetter 1985). In other words, the purpose was to assign cases to classes on the basis of their clinical attributes, but in such a way that each resultant class would be relatively homogeneous in terms of resource use. By so doing, the classification would support hospital managers in the identification of atypical episodes of care which might indicate problems of under-use with risk to quality of care, or over-use with risk of financial loss.

The potential value of DRGs as the basis for health care resourcing was recognised in the mid-1970s (Stern & Epstein 1985). The relevance of iso-resource classifications to health care funding is, in fact, quite obvious. Since each class is designed to be resource-homogeneous, it can also serve as the definition of a product which a funder may choose to purchase at, or about, the mean cost.

The DRG logic is based upon the notion that in the hospital environment, patients with acute disorders have similar needs for care and predictable patterns of resource consumption. The predictor variables might include principal diagnosis, secondary diagnosis, procedures, age, and gender

(Eagar & Hindle 1994a). Cost might be estimated with precision, or by use of indicators like length of stay (LOS).

Experience has demonstrated that not all inpatients in acute hospitals can be precisely handled by DRG classification in terms of clinical coherence or resource use prediction. To address this situation, Australian researchers and clinicians are currently developing casemix classifications for patient episodes identified as sub-acute (Eagar 1995), non-acute (Roberts, McKinley, Borrks, Ganely & Hindle 1993) and ambulatory (Michael & Piper 1991; Phelan 1995).

However, even where admitted patient episodes are defined to be acute, the DRG classification is not uniformly effective. Problems have been reported with respect to same-day and critical care episodes, and to episodes involving multiple conditions and interventions (Hindle & Halsall 1995).

Recent publications have argued that the DRG logic is less effective when the episodes concern patients with chronic conditions (Munoz, Chalfin, Birnbaum, Golstein, Cohen & Wise 1989; Stoelwinder 1990; Kravitz, Greenfield, Rogers, Manning, Zubkoff, Nelson, Tarlov & Ware 1992; Pilla 1994). The DRG assignment logic is based upon the assumption that all episodes of care relating to a particular disorder are similar in terms of diagnosis, treatment, outcomes, and resource requirements. However, it has been shown that episodes of care related to chronic disorders tend to be more unpredictable in nature and duration.

There are commonalities amongst people with a particular chronic disorder. However the sequence of care that is required in individual cases and the intensity of the interventions can, at best, only be described in general terms. It has therefore been argued that the assumptions that underpin DRG logic appear are diametrically opposed to appropriate management of people with chronic disorders. There is a need for further research to determine if that is the case.

Diabetes is a common chronic disorder which requires frequent, and often unpredictable hospitalisation for restabilisation of blood glucose level (BGL) and management of complications. The study reported here was designed to assess the extent to which concerns about the ability of the AN-DRG classification to represent resources used to manage chronic conditions are justified. Detailed analysis was undertaken of episodes involving patients who require care for the acute exacerbations and/or the complications commonly associated with diabetes. The results have implications for casemix design and application.

1.1 Aims of the study

The the focus of this study was to examine how the AN-DRG classification categorises inpatients with diabetes, and in particular to assess the extent to which the resulting assignments are clinically coherent and resource-use homogenous.

While the focus of this study is diabetes, it is expected that the findings will have wider implications in terms of the way in which the AN-DRG classification handles all types of chronic conditions. The study would also provide information of relevance to clinical documentation and coding practices.

The study was not intended to assess directly the accuracy of coding. However, clinical documentation and coding accuracy needed to be addressed to the extent that there might be implications for DRG assignment.

1.2 Organisation of the thesis

The study described in this dissertation has four main components, distributed among nine chapters.

First, there is a general survey of the nature of the classification problem. Chapter 1 provides an overview of the DRG classification system. The characteristics of DRGs are discussed and the assignment logic, which determines allocation of an episode to a DRG, is presented. Chapter 2 provides background to the development of Australian National Diagnosis Related Groups (AN-DRGs), and Chapter 3 investigates applications for the AN-DRG classification in acute care hospitals in Australia.

Second, attention is paid to the data which are available to support the process of classification and classification design and evaluation. In particular, Chapter 4 discusses issues related to coding of medical records and the implications of coding for DRG assignment. Particular issues relating to the assignment of episodes of care associated with diabetes are investigated in Chapter 5.

Third, the core research task is described, whereby data for a sample of admissions containing at least one diagnosis of diabetes are abstracted and analysed in terms of classification by DRG and in other ways. The design and methodology of the research are described in Chapter 6, results are presented in Chapter 7, and the findings discussed in Chapter 8. Alternative designs for casemix classification systems that take account of secondary diagnosis are then presented.

The final section of this dissertation involves the development and justification of a set of recommendations, which are presented in Chapter 9. Particular attention is paid to ideas regarding further development of casemix classifications appropriate for chronic disorders.

1.3 Casemix and the classification of health care products

Casemix classification is a key component of management information systems (Degeling 1994; Fetter 1985; Jackson 1995). Health care is a production system, and it is a requirement for the management of any such system that the products are able to be described, and that the cost, quality, and worth of each product is known. Casemix is no more (or less) than a scientific approach to the definition of health care products.

Casemix classifications have been developed, and put to increased use, in many countries (Palmer, Freeman & Rodrigues 1991; Pilla & Hindle 1994). The ability to categorise products allows for comparison of like with like and production of aggregate data about groups of providers. Typical uses include: identification of patient variations so that differences in quality of care, and care outcomes, can be identified and addressed; determination of the mean costs of production of each product as the basis for funding (including allocation of a capped total budget and specification of production contracts); and facilities and workforce planning.

A casemix classification must meet the general requirements of all effective classification systems, including exhaustiveness and mutual exclusiveness of final classes. However, there are two additional attributes which must be present if the classification is to be useful in terms of categorisation of health care products. First, the classification groups patients with similar disorders together to provide classes that have clinical meaning. Second, the classes are homogenous with respect to an attribute of global interest (such as cost, quality of care, or utility) (Eagar & Hindle 1994a).

The requirement for clinical meaning seeks to ensure that all episodes in a class involve similar kinds of presenting problems, management protocols and outcomes. Classifying patients according to length of stay or by divisions such as medical or surgical, does not provide clinicians, researchers or managers with adequate information about the characteristics of the patients, or the resources used in their care. However, classifying patients according to principal diagnosis, for example, diabetes aged less than 35 years, provides clinicians with some understanding of the resource implications and clinical characteristics of the patients (Eagar & Hindle 1994a).

Resource homogeneity seeks to ensure that episodes of care with similar demands for resources are assigned to the same class. Resource consumption variables include costs, charges and LOS. In practice the LOS is used as the surrogate for cost. Resource homogeneity is determined by statistical analysis using length of stay as the variable (Reid 1991).

While using LOS as a predictor of resource consumption is considered to be less than ideal (ACCC 1994; Hickie 1994), it does enable those episodes falling outside of a predetermined range to be identified. Episodes of care associated with significantly shorter or longer periods of hospitalisation are considered to be outliers and warrant investigation to identify the reasons for the divergent experiences of these patients (Reid 1991). Common reasons for outliers are coding errors, errors in diagnosis, errors and mishaps in treatment, atypical responses to the disease process and to treatment, and problems with timely discharge such as lack of nursing home accommodation. Clinically and statistically significant low and high outlier trim points have been assigned to each DRG to differentiate both the more severely ill and the less severely ill from the 'average' patients (Mullin 1985).

Attainment of adequate degrees of resource homogeneity and clinical meaning in a casemix classification is problematic for various reasons. First, some disorders are not well understood and as a result there is lack of consensus amongst clinicians regarding clinical descriptions and management protocols (Iezzoni & Moskowitz 1986). Consequently variations in resource consumption are common (Kravitz, Greenfield, Roders Manning, Zubkoff, Nelson, Tarlow, & Ware 1992).

Second, protocols may differ between clinicians for some conditions that are well understood, indicating lack of consensus regarding treatment

(Newhouse 1983). Third, local variations in coding protocols and/or inconsistent interpretation of coding guidelines compromises the validity and accuracy of data (Reid 1991; Donoghue 1992).

As noted earlier, each class must be mutually exclusive which means that there is one, and only one, correct class for each episode of care. However, in practice that is not always the case. Considerable clinical overlap has been reported between DRG classes (Iezzoni & Moskowitz 1986). For example, DRG assignment for an episode of care coded for peripheral vascular disease and diabetes, differs to the classification of peripheral vascular disease resulting from diabetes. However, the differences between the patients in terms of clinical interventions and outcomes is likely to be negligible.

1.4 A brief history of Diagnosis Related Groups

The DRG classification was developed in the United States, from work by Fetter which began in 1973 (Fetter, Shinn, Freeman, Averill & Thompson 1980). Subsequently, several major variants have emerged, both within and outside the United States. An overview of the development of DRGs in the United States, Canada and Britian is provided in this Chapter. The development of AN-DRGs is discussed in Chapter 2.

1.4.1 DRG versions in the United States

The precursor of the DRG system was designed as a quality assurance tool for categorising complete inpatient episodes in United States acute care hospitals (Fetter et al. 1980). The classification underwent refinement and in 1977 was named Diagnosis Related Groups. The main objective of the classification, which at that time comprised 383 classes, was to support the identification of atypical episodes of care which might indicate errors of resource utilisation or quality of care (Fetter 1985; Fetter, Brand, & Gamache 1991). The general logic of the DRG assignment process, which is described later in this Chapter, was stabilised at that time.

The DRG classification was adopted for use in the per case payment trial in New Jersey in 1979 to replace the cost-based reimbursement system (Stern & Epstein 1985). A prospective payment system was introduced and a predetermined payment, according to DRG, was applied for each patient treated. The goal was to improve efficiency, reduce administrative burdens on hospitals, and improve access to quality health care.

The relative success of the trial encouraged the Health Care Financing Administration (HCFA) to introduce its DRG-based prospective payment system for Medicare in 1983 (Stern & Epstein 1985). The intention was to limit the rate of growth of health care expenditures by ensuring that United States Medicare became a more 'prudent buyer" of health services. The classification has been modified almost every year since then. The 1983 version, known as HCFA-3, had 470 classes and the 1992 version (HCFA-9) had 492 classes (Hindle 1992).

The CC exclusion list was also introduced. Early HCFA versions used a single list of CCs which applied in all cases. The CC exclusion list defined cases where some CCs do not apply (that is, are not considered to be significant secondary conditions) for particular principal diagnoses.

In 1987 the New York State Department of Health introduced an alternative DRG classification as the basis for payments to all hospitals in the State. Called the NY-5, it was a derivative of the 5th version of HCFA-5. The New York (NY) versions differ from HCFA in definition of the secondary diagnosis and the increased number of neonatal DRGs. The NY versions also contain the non operating room (OR) procedure modifier which, if present, causes some secondary diagnoses to become major CCs. Like the recent HCFA version, the NY versions had adopted the `CC exclusion list' (Pilla & Hindle 1994).

A major difference between these two classifications is that the NY versions can be applied across the entire population rather than mainly the elderly or young as is the case with HCFA versions.

Development of a third variant, known as the Refined DRG or RDRG system, was commissioned by HCFA. The logic of the RDRG system used CCs to split medical clusters into three groups and procedure clusters into four, resulting in 1200 final classes. The CCs splits replaced the previous age splits. The RDRG variant has not been widely adopted (Pilla & Hindle 1994).

1.4.2 British DRGs (Healthcare Resource Groups)

Government interest in DRGs is relatively recent in the United Kingdom, stimulated largely as a result of purchaser-provider arrangements (Pilla & Hindle 1994). The first official version of Healthcare Resource Groups (HRGs) was released in 1992. A two-year update cycle was planned with version two released in 1994 and version three scheduled for release in 1996.

Version one had 518 classes, and the draft of the second version had 564 classes. Additional classes include those created through splits of diagnosis and procedure clusters, in addition to cluster splits on age. Clinicians have been involved in development of the HRGs and as a result the classification has been altered to reflect United Kingdom practices.

1.4.3 Canadian DRGs (Case Mix Groups)

The Hospital Medical Records Institute (HMRI) has been instrumental in the development of Case Mix Groups (CMGs) in Canada. The organisation is a non-profit-making agency funded in by the Canadian Hospital Association and the Canadian Medical Association (Pilla & Hindle 1994).

The first version introduced in 1983, was virtually unchanged from the HCFA-3 upon which it was based. The second version, released in 1990, incorporated major modifications as a consequence of thorough consultations and intensive analyses. Some features of the New York variant have also been introduced (Hindle 1992; Pilla & Hindle 1994).

One consequence was that the number of classes increased from 472 to 535. Its designers argued that major changes were justified on the grounds that:

> "... the philosophy of healthcare, length of stay patterns, and funding approaches are all different in Canada compared to the US. Importing a single version of DRGs for use in Canada could lead to the incorporation of US funding incentives and disincentives in our health care information systems." (Pilla & Hindle 1994: 88)

Clinicians in Canada argued that imported versions did not adequately explain variance in the Canadian acute care hospital patient population. The latest version, released in 1993, has 564 classes and remains structurally similar to the HCFA versions.

In summary, it can be seen that the design of the DRG classifications differs between, and within, countries. While the essential elements of the DRG classification remain the same, their interpretation differs to reflect clinical practice and the philosophy and priorities of national health authorities. For example, several variations of the DRG classification are applied concurrently in the United States, and no single variation is applied to all inpatient episodes. The DRG classification is primarily applied to cases funded by Medicare and Medicard systems.

The reasons for this selective and differential application of the DRG logic warrants further consideration. Within the hospital setting, clinicians have observed that patients with the same disorder may differ in their need for care and hence, utilisation of resources. Therefore, conclusions made from data across all patient episodes can be problematic for both clinical and resource planning. This study has been designed to investigate the efficacy of AN-DRGs to group patients with a common chronic disorder into groups that are clinically meaningful and iso-resource.

1.5 Data requirements for DRG assignment

Many groups of clinicians, academics and administrators have been involved in the development and ongoing refinement of the DRG logic and categories (McGuire, 1993). In an attempt to ensure that the limitations of previous patient classification schemes were not repeated in the AN-DRG classification, and to avoid delays to the development process by physician panels and statistical analysis, the following criteria were adopted as the guiding principles of the classification:

A. the patient characteristics would be limited to those available from routine hospital data

B. there would be a manageable number of DRGs which encompass all patients seen on an inpatient basis

C. each DRG should contain patients with similar patterns of resource intensity (resource homogeneity)

D. each DRG should contain patients who are similar from a clinical perspective (clinical homogeneity)

(McGuire 1993; Eagar & Hindle 1994a).

Restricting information to that which is already routinely collected, and therefore readily available in the hospital, was a significant requirement that was included to ensure that DRGs could be widely applied. Limiting DRG classifications to manageable numbers was considered necessary to ensure that hospitals would have sufficient numbers of cases in each group to allow meaningful comparative analysis to be performed.

The requirement for resource homogeneity by patients assigned to each AN-DRG was considered to be necessary in order to establish a relationship between the casemix of a hospital and the resources consumed. While it is not possible for each patient in a DRG to be identical, it is important that all patients assigned to a particular DRG are sufficiently similar to allow the accurate prediction of resource needs for the overall group. Finally, a casemix classification will be of little use unless the data are grouped into categories that are logical according to current clinical practice.

1.6 AN-DRG assignment logic

At first glance the logic by which an episode of care is assigned to a DRG classification appears to be straightforward. However as with any complex system, closer examination reveals a complicated set of rules, regulations, exclusions and guidelines.

The AN-DRG logic is based upon the notion that in the hospital environment, acute disorders have predictable patterns of resource consumption (Eagar & Hindle 1994a; McGuire 1993). Therefore classifying episodes of care into homogenous groups based upon common variables, provides information about the casemix of the hospital for reimbursement, management, and quality assurances purposes. In practice, length of stay has been adopted as the arbitrary surrogate for resource consumption.

However, in health care, progress from onset of treatment to recovery can be predetermined for only a minority of disorders. Therefore, while it is technically possible to group all patients according to identified variables, individual characteristics dictate that patients in the same group will be heterogenous in other variables. This has proved to be the case with the DRG classification. The classification groups patients primarily according to the identified principal diagnosis. However, that logic overlooks the facts that patients may have more than one condition, and that one disorder can directly, or indirectly, influence the onset, progress and management of concomitant disorders.

Data for DRG allocation are obtained after discharge from the completed discharge summary sheet. Allocation takes the following data elements into account:

principal diagnosis	significant secondary diagnosis
age of the patient	gender of the patient
surgical procedures	discharge type (transfer, death, home etc)

Diagnosis and procedures are described using codes from the International Classification of Diseases (ICD), currently in its 9th Edition. The codes have undergone clinical modification (CM) to achieve clinical validity. For expediency the classification is abbreviated to ICD-9-CM. Version 3 of the AN-DRGs, which was introduced in July 1995, contains 667 classifications.

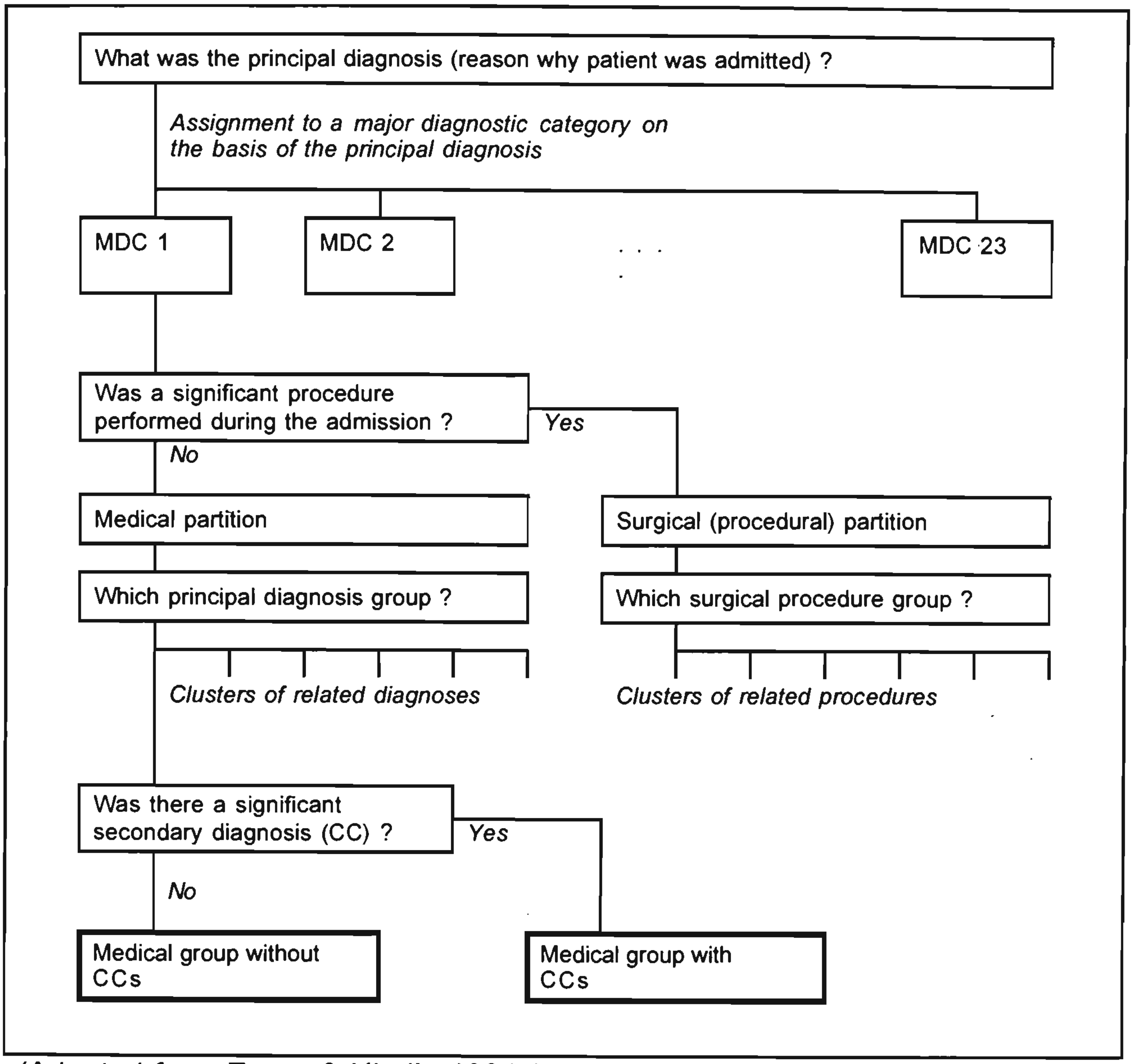
An episode of care is first assigned to one of 23 major diagnostic categories (MDCs) based upon body system, (for example MDC 5, Diseases and Disorders of the Circulatory System), and type of disorder, (for example MDC 18, Infectious and Parasitic Diseases Systemic or Unspecified Sites). At this level, assignment is directed according to the principal diagnosis for a medical condition, or a significant procedure for surgical conditions. Table 1-1 lists the 23 MDCs used for assignment to the AN-DRG classification.

Table 1-1 : major diagnostic categories, AN-DRG system

1	Diseases and disorders of the nervous system
2	Diseases and disorders of the eye
3	Diseases and disorders of the ear, nose, mouth and throat
4	Diseases and disorders of the respiratory system
5	Diseases and disorders of the circulatory system
6	Diseases and disorders of the digestive system
7	Diseases and disorders of the hepatobiliary system and pancreas
8	Diseases and disorders of the musculoskeletal system and connective tissue
9	Diseases and disorders of the skin, subcutaneous tissue and breast
10	Endocrine, nutritional and metabolic diseases and disorders
11	Diseases and disorders of the kidney and urinary tract
12	Diseases and disorders of the male reproductive system
13	Diseases and disorders of the female reproductive system
14	Pregnancy, childbirth and the puerperium
15	Newborns and other neonates with conditions originating in the perinatal periods
16	Diseases and disorders of the blood and blood forming organs and immunological disorders
17	Myeloproliferative diseases and disorders, and poorly differentiated neoplasms
18	Infectious and parasitic diseases (systemic or unspecified sites)
19	Mental diseases and disorders
20	Alcohol/drug use and alcohol/drug induced organic mental disorders
21	Injuries, poisonings and toxic effects of drugs
22	Burns
23	Factors influencing health status and other contacts with health services

Assignment is then to either a cluster of related procedures, if in the surgical partition, or to a cluster of related principal diagnoses for the medical partition. The majority of the diagnoses and procedure clusters are then split into age categories, usually at 18 years and 70 years. Finally, some of the medical clusters (and especially those for patients over 18 years) then split into parts with or without significant secondary diagnoses (CCs). Other variables are used in rare cases, such as type of discharge (Eagar & Hindle 1994a). Figure 1-1 illustrates the AN-DRG assignment logic described in this Chapter.

Figure 1-1 : general logic of the DRG classification



(Adapted from Eagar & Hindle 1994a)

The principal diagnosis (PDX) is defined in Australia as:

> "...that diagnosis or condition established after study to be chiefly responsible for occasioning the patient's admission to hospital".

(National Health Data Committee 1995:3-83)

The principal procedure is defined as:

> "The most significant procedure that was performed for treatment of the principal diagnosis".
>
> (National Health Data Committee 1995:3-89)

The principal diagnosis and principal procedure are determined after discharge from information provided by the clinician on the discharge summary (Eagar & Hindle 1994a).

Within the surgical partition of each MDC, AN-DRGs are arranged in a hierarchy according to the resource intensity of the procedures performed. In episodes of care involving more than one procedure, allocation to a final class is determined by the most resource intensive procedure. Therefore it is not necessary to select a principal diagnosis in surgical episodes of care (Eagar & Hindle 1994a).

Further differentiation is made on the basis of the involvement of a significant secondary diagnosis (CCs). A secondary diagnosis is considered to be significant if it increases length of stay by one day or more for 75% of patients (Eagar & Hindle 1994a:14). Age, gender and type of discharge may also affect the assignment at this level.

The definitions of a secondary diagnosis, comorbidity, and complication are provided in "Definition of Terms" .

Modification of the DRG classification for the Australian system resulted in some preassignment discrimination and classification of cases outside of the standard logic described above. Episodes of care that identify neonates aged less than 29 days, HIV diagnosis, liver transplants, bone marrow transplants, multiple trauma and tracheostomy are assigned to predetermined DRGs regardless of other diagnoses or procedures. These categories are known as pre-Major Diagnostic Category Diagnosis Related Groups and they differ from other DRGs in that they may occur in any of the other 23 Major Diagnostic Categories according to the principal diagnosis, (National Health Data Committee 1995:3-107).

While Australia has adopted 23 MDCs as a basis for assignment, two additional MDCs were created during development of the HCFA version 7; MDC 24, Multiple Significant Trauma, and MDC 25, Human Immunodeficiency Virus Infections (3M Health Information Systems 1990).

1.7 DRGs and resource allocation

Casemix-based funding means no more (and no less) than use of clinical measures to define classes of products for which health care providers are to be paid at standard rates per class.

A simple paradigm adopted for this thesis is that health care makes progress largely by being able to compare, and hence being able to find differences in outcome, quality, or cost. Categorisation is therefore essential, in order to ensure that like is compared with like. Once the categories have been established, they can support many uses including payment. Having defined classes so that they are resource-use homogeneous, it makes obvious sense to use the estimated average cost for each class as the determinant of payment per class.

The main constraint to implementation was that of classification design. It was necessary not only to create clinically coherent classes but also to ensure they were relatively homogeneous in terms of cost. Classifications became progressively more effective with respect to clinical attributes (and presenting conditions and health care interventions in particular). They were limited in their relevance to funding, however, because they were not at the same time effective predictors of cost. The skill and the tools were deficient to allow the simultaneous consideration of both kinds of attributes.

Several developments occurred at about the same time, in the late 1960s, which made progress possible and desirable. Once classifications began to emerge which met the requirements, their application to funding was inevitable.

The DRG classification was the most sophisticated casemix classification during the 1970s, and it was therefore the logical selection as the basis for the US Government's prospective payment system in 1983, following a trial of the approach in the state of New Jersey from 1979 (Iglehart 1982).

DRGs were adopted as the basis for many US hospital payment models from 1985 onwards, and this stimulated the development and application of several competing classifications. For example, the major US private insurer, Blue Cross, sponsored the development of Patient Management Categories as a direct competitor to DRGs. After 1986, Resource Utilisation Groups and several other similar systems such as the California Long-Term Care System, were developed for the primary purpose of supporting casemix-based payments for nursing home care. HCFA sponsored the development of several ambulatory classifications after 1986 including Ambulatory Patient Groups. The US Veterans Administration introduced a relatively comprehensive mix of classifications (including DRGs, RUGs, and its own home care classification) to support budget-share funding of its providers after 1989. Specialised classifications have been introduced since 1986 for most types of services including paediatric and psychiatric acute care, intensive care, and rehabilitation (Stern & Epstein 1985).

The history of casemix-based funding has taken a different path in Australia, for one particularly important reason. Unlike the USA, Australia has had little difficulty in controlling overall expenditures. Therefore there was a dominant view from the outset that the aim of application of casemix classifications was to encourage a more sensible allocation of existing resources, rather than to control overall expenditures (Degeling 1994; Eagar & Hindle 1994a).

After 1985, Victoria and South Australia began to develop the tools to support the allocation of resources to hospitals by use of DRGs. Victoria was the initial leader, but was unable to implement changes. South Australia developed its DRG-based Funding Allocation Model in 1987, and used it to distribute resources among the major hospitals until 1993.

Victoria found new energy by 1993, and was the first State to make use of DRGs to fund all its hospitals (in financial year 1993-94) (Duckett 1995). South Australia adopted a similar model in 1994-95, as did Queensland from January 1995 (Galbraith 1995c). Most of the funding responsibilities in New South Wales are devolved to area and district health authorities. Several began to use their own approaches to DRG-based funding after 1993, and the State government mandated use of a standard model from 1996. Like Queensland, New South Wales has employed a preliminary step whereby budgets are allocated among geographical areas, and then casemix measures are applied to the funding of health care delivery units within each area (Galbraith 1996).

Western Australia has paid particular attention to the separation of purchaser and provider functions within the public health services sector. However, the same kinds of measures of casemix are applied to the structuring of purchaser-provider contracts.

By 1996, all State and Territory health authorities had begun to use DRGs as the basis for resource allocation. There have been many similarities. In particular, all public sector payers have relied on a budget-share model. In other words, health care delivery units are given target volumes, and the available funds are then distributed in proportion to those volumes after weighting for casemix. Payment models (whereby additional payments are made for additional work above the targets) have applied only at the margins.

Clinicians and health service administrators have been involved in fierce debates about the effectiveness of casemix-based funding. Clinicians have tended to have the greatest concerns. For example, it has been argued that it will ultimately result in decreases in the quality and volume of services, discrimination against patients who are costly to treat (Stern & Epstein 1985), and be an incentive for facilities to code episodes of care to achieve optimum reimbursement (Simborg 1981). Administrators and funders of services have tended to be more positive about DRG-based funding, and have emphasised its potential to increase productive efficiency (Duckett 1988; McGuire 1993; Jackson 1995).

The postive arguments have tended to dominate. A common view has been that casemix-based funding has the potential to significantly change established ideas about health care delivery and overcome the problems related to cost-based reimbursement (Stern & Epstein, 1985; McGuire 1993). Other authors have emphasised the potential for increased control of hospital costs (Wennberg, McPherson & Caper 1984), and the stimulation of clinicians regarding control of practice variations and cultural change regarding responsibilities for resource management (Wood, Palmer & Thomas 1985; Stern & Epstein, 1985; Ferguson 1994; Pilla 1994).

The implications for individual classifications of patients (Smits & Watson 1984; Ben-Tovim & Elzinga 1994; Cleary, Ashby, Jelinek & Lagaida 1994; Phelan 1994b; Price 1994), types of services (Bartlett 1988) and for health care facilities (Lloyd & Rissing 1985; Donoghue 1992), have also been raised in the literature. It is interesting to note that the concerns and problems identified in America in the early 1980s are now being discussed by Australian authors. The opinions of Australian and international authors will be analysed further throughout this thesis.

There are many practical difficulties, including those associated with estimation of the mean costs per class. It is generally the case that absolute costs are secondary to cost weights, defined as follows:

> "A measure of the average cost of an AN-DRG, compared with the average cost of a reference AN-DRG. Usually the average cost across all AN-DRGs is chosen as the reference value, and given a weight of 1."
>
> (Eagar & Hindle 1994b:6)

Thus each casemix class (for example, each DRG) has a unique cost weight estimated to reflect the intensity of resources, including both fixed and variable costs, associated with providing patient care. It is normally (but not always) the case that all types of inputs (medical, hotel, nursing services, etc) are intended to be reflected (Eagar & Hindle 1994a; Commonwealth Department of Health and Family Services [CDHFS] 1996). However, some cost components are more difficult to measure than others. Particular problems are often encountered with respect to costs associated with non-DRG episodes of care (such as outpatient and rehabilitation services), capital, teaching and research (Stoelwinder 1990).

Many other problems must be handled. For example, provision must be made for individual episodes which do not fit the classification. The risks of gaming, where hospitals code episodes of care to maximise reimbursement, must be taken into account, as must the potential threats to quality of care including those associated with choosing to treat only low-cost or high-profit patients.

In spite of the difficulties, the trends are appropriately away from the reimbursement of input costs and towards progressively more sophisticated casemix-based funding models (including those which make use of extended episode of care classifications). This is simply a matter of logic: funding on the basis of clinical attributes presents technical and ethical problems, but there is no other option.

CHAPTER 2

DIABETES AND THE AUSTRALIAN DRG VARIANT

DEVELOPMENT OF A DRG CLASSIFICATION FOR AUSTRALIA

REVIEW OF DIABETES CLASSIFICATIONS FOR VERSION 3

Chapter 2 Diabetes and the Australian DRG variant

In 1988, the Commonwealth Government launched a five year program to introduce DRGs into acute care hospitals for funding, quality assurance and review purposes (Palmer, Freeman & Rodrigues cited in Fetter et al. 1991). The initiative, contained within the 1988-1993 Medicare Agreements, provided additional development funding of $29.3 million for the support of casemix-related research. Projects to develop the AN-DRG grouper, national AN-DRG costweights, the COSMOS cost weighting system and national education and training modules, have been supported by funding from this source ([CDHFS]1996).

From the early 1980's researchers and healthcare administrators had been observing international developments with increasing interest. Australian authors discussed the impact of DRGs upon the management systems of hospitals, (Wood et al. 1985) the value of DRGs as a strategy to promote efficiency, (Palmer 1986) and the implications for health professionals (Cuthbert 1986). The importance of obtaining accurate documentation, and the difficulties that presented, was also raised an issue (Roberts, Reid & Irwin 1985).

The Australian Casemix Clinical Committee (ACCC) was established in 1990 to make recommendations about the development of DRGs in Australia and to co-ordinate the clinical evaluation of the classification (ACCC 1994a).

Decisions regarding development of a DRG classification for Australian use, the AN-DRGs, was undertaken by a group comprising the ACCC and clinical bodies such as the Royal Colleges, speciality societies, the Australian Medical Association (AMA) and the Australian Nursing Federation (ANF).

In this chapter the development and implementation of AN-DRGs is reviewed with a particular focus upon the modifications in version 3 for assignment of diabetes related episodes.

2.1 Development of a DRG classification for Australia

Australian health authorities began to use the DRG classification after 1985, largely as a consequence of the United States experiences with DRG-based funding (CDHFS 1996). Most users selected HCFA-3, the third version developed and used by the United States Federal Government's Health Care Financing Administration, and this was retained until 1992 by most agencies. Victoria changed to HCFA-5 in 1991 (Reid et al. 1991).

The decision to develop an Australian variant was taken in 1991 following evaluative work in South Australia and New South Wales (Hindle 1992). The main considerations that lead to this decision were as follows:

- the HCFA versions are oriented towards elderly patients, whereas DRGs in Australia were intended to be applied to the entire population

- concern about issues of copyright with respect to the New York variant

- the importance of involving Australian health professionals in the development of a local system

- the requirement that the terminology and logic should reflect Australian practice.

The vehicle for development work was determined to be the Casemix Develpment program, which was initiated in 1988. A major study was conducted over the period 1989-1990 to determine a standardised strategy for Australia (Reid et al. 1991). The program encompassed the 'Australian Acute Patient Classification Project' which focussed on DRG development. However, there were many associated activities including education, coding and documentation standards, classification, costing, information technology, utilization review, quality assurance, and financing reform (McGuire 1993). The support provided by this project has facilitated the development of several kinds of tools to assist the implementation of casemix in Australian hospitals.

Three versions of the Australian DRG classification (the Australian National Diagnosis Related Groups or AN-DRG system) have been used thus far. The first version of AN-DRGs was released in June 1992. It was based on a relatively recent US variant, but incorporated some modifications to reflect the

Australian health care system. From that date, virtually all Australian users in the public and private sectors accepted it as the standard for a wide variety of purposes including funding, quality assurance, utilisation review, and facilities and manpower planning. It is important to note that while the AN-DRG classification has been accepted as the standard, there are variations between the States with respect to cost weights and models of AN-DRG funding (Hindle 1992).

Version 2 was released in 1993 following modifications which resulted in the deletion of eighteen DRGs, modification of 24, and creation of 21 new categories. There was only a minor increase in final classes, however, from 527 to 531 (ACCC 1994a; Hickie 1995). Version 3, which has 667 classes was released in 1995 following extensive consultation with clinicians that resulted in major restructuring (ACCC 1994b; McGuire & Bender 1995).

The process of classification refinement depends on the ability to analyse large databases. However, this is not sufficient in itself: the search for improvement must be informed by clinical knowledge, if only because of the high volumes of options. The ACCC has played the central role in ensuring access to adequate and appropriate expert clinical knowledge. It has been supported by other clinical groups which have been approximately arranged in accordance with the MDC structure and have comprised representation of all professional disciplines involved in acute inpatient care (McGuire 1993).

2.1.1 AN-DRG version 1

The first version was released in July 1992 (ACCC 1994a; McGuire & Bender 1995). The classification was based upon the United States All-Patient-Refined DRGs Version 7.0 (APR 7.0) developed by HCFA with some modifications to reflect Australian clinical practice (ACCC 1994a; McGuire & Bender 1995). Version 1 was organised into 23 MDCs, and a category each for errors and exceptions.

As a result of the modifications to reflect clinical practices and reporting in Australia, AN-DRGs have the following features (Eagar & Hindle, 1994a):

- AN-DRGs are primarily binary, that is, cases in the same diagnosis are split according to CCs into DRGs with CCs and DRGs without CCs;.
- the paediatric split is age 10 rather than age 18 as is used in other countries;
- AN-DRGs introduce classes not shared by DRG classifications in other countries;
- AN-DRGs have unique classification criteria including modification to the CC lists, and some high cost episodes;

- birth weight is taken into account in allocation.

Additional modifications included change of DRG labels, alternations to the CC list or special problem lists, modification to decision trees, multi-way exchange and split of DRGs, partial restructuring of one MDC and complete restructuring of another, cross MDC reorganisation, and changes for exceptional patient classes (McGuire 1993).

The age splits were unique. Version 1 was based largely on the HCFA and New York All Patient (AP) variants, and therefore adopted the general model of splitting only between neonates, children and adults (CDHFS 1996). It incorporated the New York age definition of neonates, but changed the boundary between children and adults from 18 years to 10 years on the grounds that this had greater clinical meaning and, as a result, was likely to improve the statistical analysis of the classification. The ACCC requested that there be further research before production of version 2 to ensure that the recommended changes to the age splits did not compromise homogeneity (Hindle 1992).

Version 1 also adopted a similar approach to HCFA for the classification of secondary diagnoses, albeit with a few exceptions. Most splits were binary (with or without CCs). There were no major CC classes of the kinds used in New York versions, but a few three-way splits on CCs were introduced (none or minor; moderate; and major) as replacements for binary splits (Hindle 1992; McGuire & Bender 1995).

This was a compromise solution. Some clinicians clearly preferred making extensive use of the RDRG logic whereby splits on CCs are into three for medical cases and four for surgical cases. However, there was concern about the large number of additional classes (Hindle, Scuteri & Van Der Wel 1990). Moreover, more detailed splitting on CCs was difficult to justify on statistical grounds as a result of relatively low volumes of reliable discharge data, and the variability of recording of secondary diagnoses by Australian hospitals. For this and other reasons, some of the final binary splits on CCs present in United States versions were eliminated (McGuire & Bender 1995).

2.1.2 AN-DRG version 2

Relatively few changes were made between versions 1 and 2. This was largely a consequence of the short interval between release dates (only one year) (Hindle 1992; ACCC 1994a).

Only minor changes were made in version 2 with regard to use of age. Several splits at age 10 years, which were considered to be inappropriate from a clinical perspective, were eliminated. In some instances modifications were based upon statistical performance of existing groups, that is, there were few cases in the sub-groups and the mean differences were small. In a few cases the age splits were replaced by CC splits (ACCC 1994a).

Similarly, there were few revisions relating to the use of secondary diagnoses. Changes mostly comprised adding CC splits where appropriate to both medical and procedural DRGs, with a new three-way split implemented for AN-DRG 578 (other kidney and urinary tract diagnoses). AN-DRG 557 (Transurethral procedures) was revised from a two-way to a three-way split of CCs (ACCC 1994a).

Because it recognised that factors other than the principal diagnoses impacted upon LOS, the ACCC recommended that factors such as CCs, age (for the elderly) complex medical diagnoses (for example malignancy) and multiple procedures be considered for future revisions (ACCC 1994a; McGuire & Bender 1995).

Revision of version 2 AN-DRGs was undertaken as a precursor to development of the third version of the classification (ACCC 1994b). The review commenced in 1993 with the ACCC inviting 120 clinical organisations, health authorities and hospital associations to participate. Eighteen clinical panels were established to ensure a thorough and valid clinical evaluation of version 2 (McGuire 1993). This approach to the review was undertaken for two reasons:

- not all clinical bodies participated in development of version 2, and as a result limitations in the clinical application of the classification had been identified

- it was envisaged that version 3 would be in place for some time and that the classification would be a basis for hospital funding in several States (ACCC, 1994b).

In summary, the findings were that while the second version was a marked improvement on the original HCFA DRG classification introduced in version 1, there were underlying weaknesses that needed to be addressed. The difficulties imposed by inadequate measures of severity, the ICD-9-CM codes and lack of clinical validity, were identified as limiting factors to the AN-DRG classification. The ACCC (1994b:2-3) summarised the findings of the review as follows:

- deficiencies in the ICD-9-CM coding
- poor quality clinical data
- inadequate coding standards
- lack of clinical precision of existing AN-DRGs
- a need to create additional AN-DRGs to improve clinical and statistical homogeneity
- failure of current categories to account for high cost but low volume treatments

- failure of current classifications to reflect the true cost of the episode of care
- restructuring of MDCs 19 and 20 to more accurately reflect the cost of mental illnesses
- a need to evaluate other casemix classifications
- opportunities to research classifications for oncology, burns, mental health, intensive care, paediatrics and case complexity
- a probable need to modify casemix constructs to accommodate complexities of some disorders
- inability to account for 'social conditions'.

The ACCC (1994b:2) also noted that "...length of stay is not a particularly robust surrogate for cost...". Finally it recommended that other components of care be included in future evaluation of proposals for additional AN-DRG categories.

In addition to the recommendations for modification of MDCs received from all Clinical Groups, general recommendations were made relating to the ICD-9-CM coding classifications, CCs, paediatric and geriatric casemix, malignancy, high cost/low volume categories, percutaneous and endoscopic therapeutic procedures, mechanical ventilation, shared AN-DRGs, sameday classifications, and statistical guidelines (ACCC 1994b). Recommendations of the ACCC were reviewed and future research needs and opportunities identified.

One recommendation of relevance to this study, was that increased emphasis should be placed on the clinical factors which impact on the complexity of care and result in increased resource utilization (ACCC 1994a). If reimbursement is to be based on the cost of providing care, which is the principle of a casemix-funding model, modifications to the current AN-DRG classification will be required. The ACCC has correctly identified the need to develop measures of severity which would account for the increased resources that are used to manage complications, comorbidities and complex principal diagnoses.

2.1.3 AN-DRG version 3

Significant changes to the existing AN-DRG classification were made during the development of version 3 (Hindle 1992; ACCC 1994b). Table 2-1 presents a list of the MDCs adopted for version 3. Unlike the procedure adopted for the development of versions 1 and 2, a structured program of consultation with clinical practitioners was established. Version 3 incorporates new ICD-9-CM codes, some principal diagnosis were allocated to different or new AN-DRGs and AN-DRGs containing insufficient episodes were deleted.

Table 2-1 : AN-DRG pre-MDC and MDC structure, version 3

Pre-MDC DRGs :	
1	Mouth larynx or pharynx with tracheostomy age greater than 15
2	Mouth larynx or pharynx disorder with tracheostomy age less than 16
3	Tracheostomy other than for mouth, larynx or pharynx disorder age > 15
4	Tracheostomy other than for mouth larynx or pharynx disorder age less than 16
5	Liver transplant
6	Bone marrow transplant
MDCs :	
1	Diseases and Disorders of the Nervous System
2	Diseases and Disorders of the Eye
3	Diseases and Disorders of the Ear, Nose, Mouth and Throat
4	Diseases and Disorders of the Respiratory System
5	Diseases and Disorders of the Circulatory System
6	Diseases and Disorders of the Digestive System
7	Diseases and Disorders of the Hepatobiliary System and pancreas
8	Diseases and Disorders of the Musculoskeletal System and Connective Tissue
9	Diseases and Disorders of the Skin, Subcutaneous Tissue and Breast
10	Endocrine, Nutritional and Metabolic Diseases and Disorders
11	Diseases and Disorders of the Kidney and Urinary Tract
12	Diseases and Disorders of the Male Reproductive System
13	Diseases and Disorders of the Female Reproductive System
14	Pregnancy, Childbirth and Puerperium
15	Newborns and other Neonates with Conditions Originating in Perinatal Period
16	Diseases and disorders of blood/blood-forming organs, immunological
17	Myeloproliferative diseases and disorders and poorly differentiated neoplasms
18	Infectious and Parasitic Diseases (Systemic or Unspecified Sites)
19	Mental Diseases and Disorders
20	Alcohol/Drug Use and Alcohol/Drug Induced Organic Mental Disorders
21	Injuries, Poisonings and Toxic Effects of Drugs
22	Burns
23	Factors Influencing Health Status and Other Contacts with Health Services
	Error DRGs

The main modifications for version 3 were as follows:

- partitioning based upon complicating clinical factors such as complications, comorbidities, malignancy and age

- greater recognition of high-cost/low volume AN-DRGs, non-operating room procedures and intended sameday stay, for example use of Pre MDCs, and introduction of "V" codes for screening tests and stays of less than 24 hours

- restructuring of some MDCs, for example restructuring of MDCs 19 (mental disorders) and 20 (alcohol use)

- movement of codes between MDCs and DRGs based upon clinical rationales, for example introduction of DRG 520 diabetic foot

- creation of new data edits as part of the software functions, for example edits to flag questional and unacceptable principal diagnoses.

(ACCC 1994b; Hickie 1995; McGuire & Bender 1995).

Changes in the use of age were particularly significant. The main changes were that the number of classes defined by age were more than doubled, and that many more age splits were introduced as class boundaries. Age splits at 5, 10, 15, 25, 35, 40, 45, 50, 55, 60, 70, 75 and 80 years were introduced (Hindle 1992).

Age splits were also used in combination with CCs. One model involves treating age and CCs as options, for example DRG 46 (Seizures, age <65 with CC or age >65 without CC). More complicated structures were introduced, such as that for AN-DRGs 471 to 473 (fracture, sprain, strain and dislocation of forearm, hand or foot). In this case, one class is defined by presence of age 75 or over and CC; the second is defined by presence of age 75 or over or CC; and the third is defined by absence of both (Hindle 1992).

Major changes for version 3 were also made with respect to the use of CCs. New binary splits were implemented for many AN-DRGs and more use was made of the concept of major CCs. Additional combinatory logic was also incorporated in response to the ACCC's proposal to apply the concept of Complicating Clinical Factor (CCF) (ACCC 1994b).

The ACCC (1994b:15) considered there were four main reasons why the cost of patients within the same principal diagnosis or procedure cluster might vary: CC, age, complex principal diagnosis, and complex procedure. The review recommendated that the CCs be replaced by the parameter CCF. An AN-DRG might therefore be split according to CCFs into with CCF and without CCF, where the former would indicate the presence of one or more of the four factors.

The Commonwealth adapted the idea so that the single factor which explained the largest amount of variation was chosen as the splitting variable (Hindle 1992; ACCC 1994b). As result, spinal procedures are split into with CC and without CC, while cerebral palsy is split on age. New splits were introduced which combine the factors. For example, the AN-DRG Transient Ischaemic Attack (TIA) and Precerebral Occlusion, which was split into with CC and without CC in version 2, was split into three parts in version 3, as shown in Table 2-2.

Table 2-2 : version 3 logic for AN-DRGs 67,68 and 69

Age over 79?	CC?	AN-DRG assignment
Yes	Yes	67
No	Yes	68
Yes	No	68
No	No	69

(Adapted from ACCC 1994b:72)

Similarly, the version 2 AN-DRGs for lens procedures with and without CCs were modified, so that assignment to the higher weighted class would occur if a CC was present OR if a virectomy was performed. This approach was not entirely consistent with the ACCC's recommendations, and the Commonwealth therefore activated an evaluation in early 1996 (ACCC 1994b).

As a result of clinical consultation during the development of version 3, a number of clinically valid changes have been incorporated. Clinical recommendations were supported and implemented, although not fully supported by statistical analysis. For example disorders of iron metabolism (2750) were excluded from AN-DRG 534 (inborn errors on metabolism), and reassigned to AN-DRG 753/754 (disorders of blood and blood forming organs).

However, there were instances in which clinician recommendations were rejected on the basis of statistical analysis. For example, the recommendation to include diseases of thyroid and adrenal glands in the CC lists was not implemented. While there are changes, the issue of secondary diagnoses remains largely unresolved. As a result, the quality of DRG data will continue to be compromised for funding and mortality and morbidity research.

2.3 Review of diabetes classifications for version 3

The changes to version 3 that resulted from clinical consultations, demonstrates the importance of clinician involvement in future casemix development. While assignment of cases for this study was according to version 1, the recommendations and outcomes from that consultative process are presented to demonstrate the complexity of issues relating to the design of the classification that are still to be resolved.

Of particular interest were the changes made to the codes relating to diabetes. The DRG version 1 logic for MDC 10 (endocrine, nutrition and metabolic diseases and disorders) is shown in Figures 2-1 and 2-2 (ACCC 1994b:254) to enable comparison of the changes for version 3 described on the following pages.

Figure 2-1 : MDC 10, medical partition, AN-DRG version 1

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3M Australia Pty. Ltd. 1990 p325

Figure 2-2 : MDC 10, surgical partition, AN-DRG version 1

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3M Australia Pty. Ltd. 1990 p323

The ACCC used the major diagnostic categories as a basis for its research for version 3 (ACCC 1994b). The Endocrine and Diabetic Clinical Group (EDCG) was established to review MDC 10 (Endocrine, Nutritional and Metabolic Diseases and Disorders) and other MDCs where diabetes has a significant impact upon patient care and resource consumption (ACCC 1994b:237-267). Particular attention was paid to amputation cases in MDCs 5 (circulatory system) and 8 (musculoskeletal system and connective tissue, and antepartum AN-DRGs in MDC 14 (pregnancy, childbirth, and the puerperium).

Peripheral Vascular Disease (PVD) is a common cause of complications in people with diabetes (Diabetes Australia 1988; McCarty 1996). The symptomatology relating to PVD includes ulceration and gangrene of the feet and legs often resulting in amputation. Treatment of these conditions is resource intensive, often requiring repeated hospitalisation over an extended period. These cases are likely to be relatively expensive to treat and clinically similar.

The EDCG was particularly concerned with ensuring appropriate assignment to foot disorders which are diabetes related. Clinicians generally recognised that version 1 assignment logic did not classify these patients into dedicated DRGs. These cases were distributed among many AN-DRGs, in various MDCs, and often classified with non-diabetic conditions in a clinically incoherent way (ACCC 1994b).

The main recommendation of the EDCG was that cases with diabetes-related foot disorders resulting in surgery be moved from other MDCs into MDC 10, and assigned to a revised DRG 520, the diabetic foot (ACCC 1994b). Other changes proposed to DRG 520 were incorporation of the whole of AN-DRG 523 (skin graft and wound debridement for endocrine, nutritional and metabolic diseases and disorders), and several procedures currently included in DRG 528 (other OR procedures for endocrine, nutritional and metabolic diseases and disorders). The procedures to be moved should include disorders of the cardiovascular system involving the lower limb such as the following ICD-9-CM codes: 3818 (endarterectomy), 3838 (resection of vessel with anastomosis), 3848 (resection of vessel with replacement), 3868 (aorta-iliac-femoral bypass), and 3998 (control of haemorrhage).

The inclusion of ICD-9-CM procedure codes such as 7738 (osteoarthrotomy of tarsals and metatarsals), 7747 and 7748 (biopsy of tibia, fibula, tarsals and metatarsals), and 7788 (partial ostectomy of tarsals and metatarsals) was also recommended. Other musculoskeletal procedures to be relocated included codes 8088 and 8098 (excisions of joint, tarsals and metatarsals) and 8111 (ankle fusion) (ACCC 1994b).

In order to ensure precision of assignment, attention to the presence of diabetes as a secondary diagnosis was also recommended (ACCC 1994b). For example, DRG 234 (upper limb and toe amputation for circulatory system disorders) would continue to exist, and only those amputations associated with diabetes would be moved to the new AN-DRG 520. This recommendation, with minor modification, was supported by statistical analysis of LOS data undertaken by the Commonwealth Department of

Human Services and Health. However, it was not supported by the majority of members of another advisory body, the Technical Reference Group (TRG), which largely comprises non-clinical experts.

The TRG had a general concern with respect to added complexity. The ACCC had proposed the idea of 'shared DRGs'. In brief, this involves, for example, allowing a DRG to belong to more than one MDC (as was the practice in the United Kingdom's first version of its Healthcare Resource Groups classification) (Hindle 1992).

In the particular case of foot disorders, the ACCC was arguing that a principal diagnosis and procedure combination could result in assignment to a DRG in the circulatory system MDC, but should be assigned to MDC 10 if the condition was associated with diabetes. Presence of diabetes as a secondary diagnosis would allow this model to be operationalised. The TRG was more concerned about the general concept, and the resultant added complexity, than about the particular problem of categorisation of patients with diabetes.

Evenutally, the ACCC's recommendation was accepted, and a revised and renamed DRG 520 has been included in AN-DRG version 3 (ACCC 1994b). This is an excellent example of the value of knowledge of the underlying clinical processes in classification development.

On the other hand, the second major recommendation by the clinical group had a less successful outcome. DRG 520 resolved some of the problems related to cases with foot disorders which are diabetes-related and where procedures are performed. A similar approach was suggested for cases where no surgery eventuated.

In brief, the EDCG proposed that a new DRG be created in MDC 10 (labelled diabetic foot) for any case not assigned to a pre-MDC category if the principal diagnosis were any of those listed in Table 2-3 (which are currently assigned to a class in the indicated MDC).

Table 2-3 : proposed assignment rules for new DRG termed diabetic foot

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Each of the ICD-9-CM codes represents a condition which is associated with diabetes, but which leads to dominant manifestations affecting another body system. For example, ICD-9-DM code 25060 relates to a neurological manifestation of adult-onset diabetes and is therefore currently assigned to a DRG in MDC 1, neurological disorders. Code 25070 relates to a peripheral vascular disorder manifestation, such as gangrene or peripheral angiopathy, and is currently assigned to a DRG in MDC 5, circulatory system disorders.

The EDCG considered that this made little clinical sense and recommended that these codes should be classified to one AN-DRG in MDC 10 (ACCC 1994b:238). While there was statistical justification for the change based on analysis of length of stay variations, both the Commonwealth and the TRG were concerned about the added complexity. The proposal was therefore rejected (ACCC 1994b:238).

The third major recommendation concerned the two DRGs reserved exclusively for cases with a principal diagnosis of diabetes. The EDCG recommended that the binary partition at age 36years be replaced by a three-part split as follows:

> Diabetes, age over 69 years
> Diabetes, age under 70 years with CC
> Diabetes, age under 70 years without CC
>
> (ACCC 1994b:242).

The main concern over the current structure was that cases could not be split at age 36 years to indicate clinical and resource differences reliably. Other variables should be considered, such as type of diabetes, and number of years since initial onset. Pending further research, an age split at 70 years was considered to be preferable, in association with a split on CCs (ACCC 1994).

One important constraint to further refinement was imprecision of documentation and coding. Specific mention was made of problems in coding of Insulin Dependent Diabetes Mellitus (IDDM) and Non-Insulin Dependent Diabetes Mellitus (NIDDM) (ACCC 1994b). It appeared to be common practice to code IDDM diabetes for patients who are non-insulin dependent but may require insulin during admission, or where insulin is a treatment choice (ACCC 1994b). It was also frequently the case that paediatric patients were being coded as NIDDM. Another difficulty was that of differentiation between manifestations and complications in ICD-9-CM coding.

The ACCC recommended that the Australian Diabetes Society should develop guidelines for clinicians with respect to documentation of endocrine disorders, and particularly diabetic conditions (ACCC 1994b). The guidelines should discuss synonyms used by clinicians in completing the front sheet of the medical record. The National Coding Centre (NCC) should be asked to standardise guidelines on the coding of diabetes in liaison with the Australian Diabetes Society.

The DRG changes were accepted and have been incorporated in version 3. However, there were changes in both the age split and the method of use of CCs, as shown in Table 2-4.

Table 2-4 : version 3 diabetes DRGs

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When compared to the clinical recommendations of an age split based on age 69 years (refer p51), the modified form probably has few implications and it is generally consistent with the ACCC's ideas. There was a significant improvement in statistical performance, as measured by variance in LOS.

Clearly, these revisions to version 3 are significantly superior to the previous diabetes AN-DRGs shown in Figures 2-1 and 2-2. It is of interest to speculate why the age split at 36 years remained for so long. It was introduced in 1978, and has been present in United States Medicare (HCFA) versions since 1983. The simple view is probably correct: that there was a poorly formed clinical hypothesis about the nature of diabetes, which happened to be supported by partial statistical analysis. In fact, splitting on age often produces unreliable and unstable results. There is no doubt that weak relationships exist between cost and age, especially at higher ages, because of the increased number of comorbidities. However, it is often the case that splits at several different ages (such as 60 years or 70 years) produce nearly identical results; and what is optimal in one data set will not be so in another.

Another recommendation of the EDCG which is relevant to this example, concerned the transfer of a single ICD-9-CM diagnosis code (2510) from DRGs 531 to 533, nutritional and miscellaneous metabolic disorders (with age and CC splits) to AN-DRGs 529 and 530. AN-DRGs 531 to 533 are typical of several in the classifications which are residual, and therefore contain a clinically heterogeneous set of relatively low volume case types. This particular set contains two main subgroups; cases admitted to hospital because of major nutritional problems (often related to socio-economic factors), and those admitted for complicated nutritional problems. Several changes were suggested to resolve the weaknesses.

Of primary interest here, are patients with a diabetes code and a diagnosis of hypoglycaemic coma (ICD-9-CM code 2510) or hypoglycaemia not otherwise specified (code 2512) who are currently being assigned to AN-DRGs 531 to 533, because the diabetes code is not being selected as the principal diagnosis. Hypoglycaemia is almost always diabetes-related in the acute hospital population, therefore, the EDCG recommended that ICD-9-CM diagnosis code for hypoglycaemia be associated only with AN-DRGs 529 and 530.

However, statistical analysis by the Commonwealth showed that within-class length of stay variance increased, and therefore the recommendation was rejected (ACCC 1994b:245). Similar problems were noted elsewhere. For example, it appeared to be normal practice to select a diabetes-related renal condition as the principal diagnosis code (ACCC 1994b). The result was assignment to the DRG for the manifestation or clinical complication rather than to MDC 10.

The EDCG recommended changes in the set of secondary diagnoses considered to be significant comorbidities or complications (the CC list) (ACCC 1994b). One of the proposed additions was ICD-9-CM code 25000 (uncomplicated diabetes NIDDM). It was recommended that this be treated as a moderate CC for surgical cases, and a major or moderate CC for medical cases.

The Group also recommended that several diabetes codes should be upgraded in terms of their CC levels. In particular, ICD-9-CM codes 25010 and 25011 (diabetes with ketoacidosis, adult and juvenile onset), and codes 25030 and 25031 (diabetes with other coma, adult and juvenile onset) should be categorised as moderate for surgical cases, and major for medical cases. In the event, the changes could not be researched in the time available, and were therefore not implemented in version 3 (ACCC 1994b).

Finally, the Group proposed that new ICD-9-CM codes be introduced to identify admissions which are expected to require a stay of less than 24 hours (ACCC 1994b). These codes should then be used to define two new DRGs in MDC 10, as follows:

Admit for Endoscopic or other OR procedure

Investigation, management, or observation for endocrine, nutritional, or metabolic disorder.

It was recommended that some existing ICD-9-CM codes, which are currently assigned to AN-DRG 934 (other factors influencing health status), should be moved to these new DRGs (ACCC 1994b). They included V180 (family history of diabetes), and V771 (screen for diabetes mellitus). This proposal was implemented only in part with two new DRGs created for version 3, as follows:

Intended sameday admission for endoscopic or procedure for endocrine, nutritional or miscellaneous metabolic disorders

Intended sameday admission for investigation, management, or observation of endocrine, nutritional or miscellaneous metabolic disorders.

The Commonwealth analysis seems partially flawed in this case. Its report on version 3 implementation states that the ACCC's recommendation with respect to movement of some V codes from AN-DRG 934 "... was not implemented as the majority of these codes are unacceptable Principle Diagnosis codes" and are therefore not used to assign cases to AN-DRG (ACCC 1994b:251).

In summary, considerable attention has been paid to diabetes during the course of development of version 3. Expert clinical knowledge has been applied, and some useful statistical analyses have been performed. However, these changes are, in the main, directed towards diabetes as the principal diagnosis. It is possible that many weaknesses still remain, particularly with regard to treatment of diabetes as a secondary diagnosis.

The majority of admissions of patients with diabetes are not attributed directly to diabetes. However, standard clinical practice in Australia, and the high prevalence rate of diabetes complications which impact directly and indirectly upon treatments, means that resources will be directed towards managing diabetes regardless of the principal diagnosis. Significant changes to the AN-DRG logic will be required to account for the resources used to treat secondary diagnosis and these changes may not be possible within a model that is directed primarily by the principal diagnosis.

CHAPTER 3

APPLICATIONS FOR DRG DATA

DRGs AND PROMOTION OF COMMUNICATION

DRGs AND HOSPITAL MANAGEMENT STRUCTURES

PRODUCT COSTING: MEASURING THE COST OF CARE

APPLYING FUNDING MODELS TO PROMOTE EFFICIENCY

THE CLINICIAN'S PERSPECTIVE OF DRGs

UNRESOLVED ISSUES

SUMMARY

Chapter 3 Applications of DRG data

A classification of health care products should be developed with more that one purpose in mind, because there are advantages in having a common tool for multiple uses. The development of a single tool that could be appplied to provide accurate data for health service planning and funding, and also be used to measure patient outcomes would be applauded by clinicians, administrators and funders. It is therefore necessary, when evaluating a classification, to consider the possibility that less than optimal performance in one application is counterbalanced by the benefits derived in another. In this particular case, there is a need to take account of the ability of the AN-DRG classification to serve purposes in addition to that of resource allocation in the hospital funding context. This chapter therefore examines literature relating to the application of the DRG classification to a wide range of management tasks.

In the hospital setting, DRGs are synomous with casemix-based funding. Few clinicians are aware that DRGs were originally developed as a management tool (Degeling et al 1995). The classification was designed to provide a means whereby episodes of acute medical and surgical care with a LOS outside of the normal range, could be identified and reviewed (Fetter 1985). The information would be used, where necessary, to implement remedial actions and to modify those hospital procedures and protocols that contributed to the increased stay.

Prior to the development of DRGs, hospitals applied crude groupings in an attempt to provide summary data describing the services provided and the type of patients admitted (Degeling 1994). Therefore, the utility of a classification that could group patients into a number of classes according to LOS and other clinical criteria, was recognised and applied to a variety of purposes.

The first aim of this chapter is to evaluate DRG performance in four areas of organisational performance: communications, management structures, product costing and the promotion of efficiency. Clinician's perspectives of the DRG classification are discussed, as are some of the unresolved issues that arise from the application of DRGs to clinical practice.

However, one of the disadvantages of applying a single methodology to a diversity of applications is that inevitably there will be some loss of specificity and, as a result, some compromise. Inherent weaknesses in the DRG classification have been identified which compromise their performance when classification guidelines and logic are applied for other purposes. Therefore, the second aim of this chapter is to discuss ways in which the classification could be revised to reduce the effects of those weaknesses.

3.1 DRGs and promotion of communication

As is the case in other developed countries, health services in Australia are undergoing extensive change as planners and managers attempt to reorganise and reorientate resources in response to the ever increasing demand by consumers for services and technology (Braithwaite 1993; Macklin 1991). The Australian healthcare reform, of which DRGs are one component, has seen the introduction of new organisational structures, devolved responsibility to clinicians, and the implementation of management systems including health information systems (Degeling 1994). The overall objective of the reform is to "...improve public patient access and to promote structural and micro-economic reform in the hospital system" (Australian Government Solicitor 1993).

The Casemix Development Program was funded by the Commonwealth Government as one contribution to health reform. DRGs were seen as a mechanism to increase the efficiency of hospitals and the accountability of hospital managers (Duckett 1988; Duckett 1995).

It was believed that the terminology developed to describe the components of DRGs and the principles and logic that guide assignment to classes, could be used as a common language and applied to the management of hospital resources for descriptive and comparative purposes (Jackson 1995). The descriptors associated with DRGs were intended to provide consistency and replace the imprecise, opportunely obscure, and locally applied terms historically used by hospital administrators and clinicians (Rigby 1993).

That has been achieved to some extent through the adoption of common terminology to describe episodes of care for classification purposes. However, at the hospital level, there continues to be considerable variation in the methods of use, including that of defining costs associated with the production of an episode of care and of defining the products themselves (Rigby 1993).

There is ample evidence that the use of DRGs has changed the language of communication in many circumstances. For example, they have greatly facilitated increased precision and validity of the process of negotiation of hospital funding with external agencies, and increased the capability of researchers to control for casemix.

However, there is also much evidence of confusion and disillusion, in part because of the processes whereby DRGs have been developed (from analysis of large databases of summary dscriptions of patient care rather than, say, from critical paths and other types of protocols developed by clinicians in care settings). It may also be the case that confusion has been caused through overselling their utility. In summary, the potential of casemix to provide a common language relating to the products of health care has not been realised to the extent that early papers anticipated.

3.2 DRGs and hospital management structures

Across all health settings, organisations are being restructured and policies revised to achieve enhanced efficiency. Increasingly, management systems such as global budgeting, total quality management and performance linked contracts, initially designed to promote efficiency in the private sector, have been incorporated into the change strategies (Degeling 1994). Services are also being rationed through either the user pays system or waiting lists, and service priorities are under review (Hunter 1993). Authority and decision making opportunities have been devolved and financial and clinical management information systems developed. The emphasis is now upon increasing productivity with a more output-oriented and financially driven approach (Degeling 1994).

A significant change to the management structure of hospitals has been the establishment of clinical directorates which placed the responsibility for the financial and organisational management of clinical units upon clinician-managers (Rigby 1993; Degeling 1994). One of the intended consequences of this organisational change was to replace the traditional profession-based authority structures, entrenched in the hospital system, with organisational units where operating budgets were devolved and output targets defined. It was intended that much of the planning would be based on information extrapolated from DRG data describing the nature and volume of episodes of care. Results would be used to compare other units within the hospital and one hospital with another for outputs and efficiency and as a basis for ongoing planning and priority setting (Rigby 1993; Degeling 1994).

Within the directorates, removal of the artificial separations between the cost of nursing, allied health, medicine and administration, was an attempt to map the clinical products of hospitals and to establish the cost of producing episodes of care. Implementation of an out-put based approach to managing and resourcing hospital units, was considered to be a means of directing the responsibility for service decisions onto the clinician. The intention was to shift the focus of management from the attributes of inputs (such as expenditures on drugs), to features of outputs (such as the cost or outcome of an appendectomy) (Degeling 1994).

The increasing involvement of clinicians in the management of healthcare facilities presents some interesting situations, given that doctors have historically had direct and indirect influence the costs of maintaining health services (Michael 1991; Degeling 1994; Jackson 1995).

In the healthcare environment doctors continue to exert considerable power over decisions relating to priorities for distribution of resources and patterns of resource consumption (Rhodes, Krasniak & Jones 1986; Chilingerian & Sherman 1990; Degeling 1994). Non-medical managers are disadvantaged in their attempts to neutralise this power because the situation is institutionalised by social, legal and economic structures, created in part by society, and perpetuated by doctors (Degeling 1994). It is not surprising that the attitudes of clinicians towards casemix methodologies have been found to have a significant influence upon the effectiveness of DRGs as management tools in hospitals (Michael 1991; Degeling 1994; Jackson 1995).

It has been estimated that in the mid-1970s more than 80% of the total cost of acute health care was attributable to medical decisions, including the purchase of equipment and referrals for specialist consultations (Chilingerian & Sherman 1990). Up to 10% of hospital admissions were considered to be inappropriate (O'Donnell, Pilla & van Gemert 1989). Managing the productivity of hospitals is difficult, particularly given the autonomy historically provided to doctors (Degeling 1994). Therefore efforts to constrain costs need to include incentives aimed at the physicians who admitt patients (Viney, Keith & Williams 1991).

Administrators of teaching hospitals have an additional challenge under the DRG-based funding. One is that few of the current set of models take adequate account of differences in costs between teaching and nonteaching hospitals which are not fully explained by the DRG classification itself (Relman 1984). Clinicians propose that the increased costs incurred by teaching hospitals are not only a consequence of maintaining teaching programs, but also reflect the increased acuity of patients treated in these settings. On the other hand, it is also argued that teaching hospitals practise unnecessarily costly care (through, for example, the use of expensive technologies on most of their patients when they are relevant to only a fraction). The separation of the avoidable and unavoidable differences in costs is a challenge which has only partially been addressed thus far.

The issue of severity variations is being progressively addressed, but much remains to be done. Even the theoretically simpler problem of isolation of teaching and research costs remains only partially resolved (Phelan 1994b; Duckett 1995). Indeed the quandary surrounding the development of a procedure to cost the teaching and research component of hospitals outputs has not been clarified by recent attempts to cost the clinical education component of courses for health professionals (Coopers & Lybrand 1994).

The impact of devolved management responsibility, including financial management, has not been fully evaluated. Outcome indicators are still to be developed that will reliably measure the influence of clinician managers upon the services that are provided. Nevertheless, devolved management responsibilities are one facet of the cultural changes health professionals are experiencing. Therefore, perceptions and attitudes about their stengths and weaknesses will be inextricably linked to other changes, and be incorporated in evaluations of the environment.

3.3 *Product costing: measuring the cost of care*

The inability of casemix to either reduce the cost of care, or to describe all of the component costs, was recognised early in the development of the classification (Fetter, Shinn, Freeman, Averill & Thompson 1980).

In all production systems, the cost of producing the final product is germane to decisions about how the processes will operate and what the priorities will be. In health care there has been reluctance to frame episodes of patient care as products. However if the Commonwealth directive to introduce an element of casemix funding is to be effectively applied, understanding the cost elements associated with producing an episode of care is imperative for the equitable distribution of funding. Achieving that goal has proved to be difficult (Rigby 1993).

In order to accurately compare the costs of different hospitals, there must be uniform accounting and reporting practices. Rigby's (1993) study of five major teaching hospitals in New South Wales demonstrated that this was not the case, largely because each hospital had designed a system to meet its internal need for information. While each of the participating hospitals had identified cost centers for accounting purposes, there was little consistency between organisations.

As a result of the variations, Rigby (1993) concluded that comparing the cost of DRGs between hospitals using the cost centres, provided little information about the efficiency of the organisations. The author did suggest however, that the relative efficiency of individual hospitals could be determined by comparing the cost of a DRG to a standard cost for that DRG developed for each hospital. The standard cost, which would reflect variables such as characteristics of patients, nature of services, and fixed costs, would serve as a benchmark to demonstrate the target cost for clinical services. Individual hospitals could then be evaluated by comparing the cost of services against the standard cost.

While the cost per patient is of some use to facilities, it is not the only information that is useful to a service. In fact, utilization data alone is of little use. Patient characteristics need to be considered in tandem with service utilization data (Kravitz et al. 1992). Concerns have been raised about the casemix classification in this regard, and the possible negative consequences for payers, providers and beneficiaries of services under DRG-based funding has been discussed (Stern & Epstein 1985; Stoelwinder 1990; Hindle, Pilla & Scuteri 1991).

Reducing payments to facilities does not guarantee increased efficiency, (Newhouse 1983) and in fact, provides an incentive for manipulation of DRG data (Simborg 1981). Increasing throughput of patients, early discharge, decreased quality of care, and increased admissions of 'profitable' DRGs, have been put forward as possible responses by hospitals to DRG-based funding (Newhouse 1983; Stern & Epstein 1985). This was found to be the case in New Jersey where LOS decreased in DRG-reimbursed hospitals while it increased in other U.S. Hospitals (Stern & Epstein 1985). However, at the same time, the admission rate per 1000 population in New Jersey increased at four times the national rate. If this finding is supported by data from other locations, it could be concluded that DRG-based funding is unlikely to reduce admissions expect for the marginally ill (Ruth 1984).

The potential of casemix for planning and resource decision making purposes, can not be achieved without appropriate tools that have the analytical capacity to manipulate large quantities of data. The information obtained from contemporary computer analysis, is considerably more useful than traditional financial systems. Prior to computer technology, analysis was largely confined to the crude estimation of cost per day or cost per patient treated. Tools based upon the AN-DRG cost weights have been developed at the hospital level, enabling DRG data to be gainfully applied to planning and resource decisions, and to provide data for problem solving (Henderson 1991). However external comparison of costs is more difficult in practice than the theory implies, largely due to lack of consistency in cost centre construction between organisations (Rigby 1993).

3.4 *Applying funding models to promote efficiency*

The desire by Government to promote efficiency within the hospital system, is primarily driving current health reforms in Australia (Duckett 1988; Degeling 1994; Duckett 1995). The focus has moved to efficiency gains as a means of containing costs because, typically in health, efficiency is preferable, and more ethical, than rationing of services. The increasing use of DRGs in hospitals is intended to promote both allocative and technical efficiency (Duckett 1995).

Allocative efficiency is achieved when resources are allocated across competing products in such a way that optimal results are achieved for the type and volume of resources that are used (Duckett 1995). In healthcare the increasing use of community services as a substitute for inpatient care and the judicious use of expensive technologies, are examples of decisions based upon the desire to provide appropriate services and meet increasing demands within available resources.

Technical efficiency refers to the practice of allocating resources according to the nature and volume of the outputs in a way that reflects the actual cost of producing the products (Jackson 1995). The move towards paying hospitals on the basis of their casemix, rather than historical budgets, is intended to improve technical efficiency.

3.4.1 Promoting allocative efficiency in health care

It has been argued that allocative efficiency has not been well addressed in health care (Jackson 1995). The ethical issues associated with decisions regarding healthcare cannot be ignored, and the injustices associated with the all-or-nothing approach to the provision of services, introduces an element of accountability that few would take on willingly. Theoretically, managers can use casemix information to make informed decisions about the allocation and/or redirection of resources to achieve greatest health gain from resources invested.

Although the focus is being directed to allocation of resources, Sheill (1993) draws attention to the fact that within healthcare, different types of efficiencies need to be considered. For example, social efficiency, which refers to access and equity issues, is compromised by the DRG-based funding models thus far adopted.

Regardless of how healthcare is funded, there is always some form of implicit rationing. It is a factor of human nature that consumers will seek more services than are available. Equity of access is often a function of both ability to pay and availability of services. The ability of case payment to account for varying needs in terms of access to services has been questioned (Viney et al. 1991). Case payment for the purposes of productive efficiency, is just one of the commercial philosophies being adopted by Australian hospitals, in response to increasing consumerism and no growth budgets (Gilbert & Braithwaite 1994).

If funding according to DRGs is to effectively reduce costs, consideration needs to be given to opportunities for cost shifting, reducing access to free care, limiting the cost and frequency of admissions, and surveillance to monitor use of services after discharge (Stern & Epstein 1985). As Michael (1991) points out, case based funding does not mean that hospitals are paid according to what they choose to do. Some form of cost constraint by funders will obviously be a component of DRG-based funding models.

When it comes to making decisions about allocation and access to resources, there are no simple formulas. While the simplicity of the DRG concept is one of its attributes, applying the principles is complicated by the vested interests, and politics associated with healthcare (Michael 1991). The availability of large quantities of data generated, by the collection and analysis for DRG assignment, is considered to be an advantage (Hindle, et al. 1990). However, the inability of the DRG classification to explain variation in service provision, is seen as a limitation of the system that reduces its usefulness for reimbursement purposes (Hindle et al. 1990; Stoelwinder 1990; Michael 1991).

The historical funding formula used in public hospitals throughout Australia, has resulted in widely varying costs per case. Traditionally, resource allocation had little to do with the actual cost of the product, but focused instead on the cost of producing the product. Under that system, financial management of hospitals stressed the raw inputs of patient care, that is, labour, materials and infrastructure costs. Costs associated with producing care, such as nursing costs, laboratory and other diagnostic procedures and consumables, were considered to be the end products (Fetter et al. 1991). Under the DRG logic these costs are to be intermediary items and are bundled together to produce 'final products' or treated conditions.

According to Jackson (1995), funding hospitals based on historical factors, caused managers to focus outside the organisation to the external political environment. Strategies such as withdrawl of services, bed closures and media skills were used to retain their share of the health budget. In contrast, casemix-adjusted, output-based funding is seen as an incentive to establish benchmarks for comparison between hospitals, and to review clinical practices throughout the organisation (Jackson 1995). This is significant for hospital managers, because it requires an understanding of not only the cost of inputs to care, but also an understanding of the mix and intensity; the volume and cost of intermediate services. While some variation will remain, casemix classifications are considered to be a step towards 'the level playing field' (McGuire 1993).

The potential for enhancements to allocative efficiency may be increased if there is a move towards the use of classifications which explain other variations in addition to resource use. Some work has been undertaken in this regard. For example, the National Casemix Office in the United Kingdom, which has its own version of DRGs, is also developing iso-prognosis and iso-need classifications (Pilla & Hindle 1994). The aims are much the same as those which are driving the work on definition of core health services in several countries, including New Zealand and the Netherlands, although the emphasis in the United Kingdom is different.

The best known casemix classification which does not focus exclusively in resource-use homogeneity, is that developed by the Oregon State Department of Health (Brannigan 1993). It comprises 709 classes which were designed to be both iso-resource and iso-utility. This means that there are few splits of the type used in the DRG classification, whereby there are pairs (condition X with CCs, and condition X without). This is mainly a consequence of the fact that minor differences in cost tend to be overwhelmed by the common level of utility. On the other hand, there are many more Oregon classes than there are DRGs for neonatal care. This is a reflection of the fact that episodes can be little different in cost but widely different in terms of outcomes measured by Quality Adjusted Life Years (QALY) or a similar measure (Street & Richardson 1992).

3.4.2 Issues associated with promoting technical efficiency

There are primarily two types of issues to be addressed if funding according to the casemix of a hospital is to improve efficiency. The first relates to the ability of the DRG logic to assign patients into categories that are in fact homogenous in terms of actual resources consumed. The second consideration is to ensure appropriate allocation of resources relative to the outputs. Dr. Steven Duckett believes that in Australia a robust casemix classification must become '...the foundation stone of a casemix-based funding system'. (1995:18) This notion was reinforced by the State Medicare Agreements of 1993, which introduced an element of casemix funding (Duckett 1995; Jackson 1995).

Jackson (1995) has described four key assumptions that underpin the legitimacy of casemix-based payments. The first assumption, is that the payment rate is a compromise between clinical outcome and patient considerations; that is quality of care. The level of reimbursement is a benchmark, which is based on efficiency considerations, but provides adequate resources to retain an appropriate level of patient care. The second assumption is that the variances between individual DRGs are an accurate reflection of the relative cost differentials associated with the provision of care. The third assumption is that costs are not shifted between providers, and that all hospitals face the same revenue constraints. Finally, DRG-based funding does not disadvantage those hospitals treating a disproportionate number of more seriously ill patients.

The performance of DRGs against these assumptions is considered by some authors to be marginal. Reimbursement is based upon average costs, however, inconsistencies between the accounting procedures of individual hospitals makes calculation of an average cost from aggregate data difficult (Rigby 1993). The inability of the classification to take account of the severity of cases within DRGs, also mitigates against an accurate description of the average patient from which costs can be calculated (Hindle et al. 1991). As a result of this weakness in the DRG classification, variations in costs between hospitals may be attributed incorrectly to efficiency differentials (Stern & Epstein 1985).

The principle of clinical and resource homogeneity, implicit in Jackson's (1995) second assumption noted above, has also been disputed. Attention has been drawn to anomalies in the DRG classification that compromise the principle of homogeneity, and arise primarily from the way the DRG logarithm applies the ICD-9-CM codes to group patients (Mullin 1985; Iezzoni & Moskowitz 1986). In the process of allocating an episode of care to a DRG, clinically related ICD-9-CM codes are separated into different DRGs, while in other instances individual codes relating to a common aspect of a patient's care appear in different DRGs. As a result, assignment may depend upon which code is listed first.

Assumption three recognises that constraining the overall cost of healthcare is dependent upon controlling the ability of one provider to shift the cost of care to another provider (Simborg 1981; Jackson 1995). In reality, the cost of care may be shifted between the public and private sectors, from one episode of care to another, or from one provider in the public system to another (Newhouse 1983; Stern & Epstein 1985). Assumption four, that the cost of care is consistent regardless of the severity of the illness, has also been contested (Leslie, Patrick, Hepburn, Scougal & Frier 1992).

Stern and Epstein (1985) have identified the following aspects of the DRG-based funding system adopted in the United States, as having adverse consequences for the health care system. Assignment utilizes minimum information about the episode of care. Payment is based on average costs which are determined from National data rather then the cost to individual hospitals, and the system is unable to recognise, and reimburse, for all costs. These authors believe that assignment to a DRG, which is primarily based upon the principal diagnosis and the presence of particular CCs, ignores important variables that are known to influence costs, for example disease severity. The situation is further compromised because payment is based on the average cost of episodes within each DRG. The DRG funding model does not reimburse for all costs, therefore alternate methods of funding are necessary to enable hospitals to sustain services (Stoelwinder 1990; Michael 1991; Hickie 1995). In addition to funding for research and teaching, adjustments for outliers, neonates, paediatric and psychiatric care are received by hospitals to fund these services (Stoelwinder 1990).

The name Diagnosis Related Group implies that the classification is based upon recognisable diagnoses, however within the complete DRG listing, the term is loosely applied to a variety of health related states (Iezzoni & Moskowitz 1986). For example, within MDC 5, which groups conditions associated with the circulatory system, AN-DRG 261 groups patients with the symptom of chest pain. Patients with heart failure and shock, a measure of severity, are assigned to AN-DRG 252, while AN-DRGs 255 and 256 describe the pathology-related condition of atherosclerosis.

It would be unfortunate if the opportunities for easier gains in productive efficiency were missed through attempting the much more difficult task of definition of value. However, there is clearly a need (and some small degree of practical opportunity) to seek a mix of improvements in future. For example, there appear to be circumstances in which it would make sense to adjust prices to encourage one form of intervention rather than another, or to set activity targets to reflect views about utility-to-cost ratios.

One of the risks associated with exclusive or excessive reliance on iso-resource classifications, is that minor reductions in the cost of creating products is encouraged, however the product may have little or no value at any price. Indeed, there is evidence that this has already happened in casemix funding contexts in Australia. For example, additional admissions have been reported which were not necessary, and discharges have been delayed in order to qualify the episode as a higher-paying outlier (Rhodes et al., 1986; O'Donnell et al. 1898; Viney et al. 1991; Iezzoni, Foley, Daley, Hughes, Fisher, & Heeren 1992). These were not, however, a consequence of fundamental weaknesses in the ideas of casemix funding, but rather of errors of detail in the design. More importantly, problems of appropriateness existed before the change.

While DRGs were intended to stabilize the cost of care, that goal has not been achieved with the models implemented to date. This finding has been attributed in part to the imprecise logic of the classification, and in part to the way the classification has been applied by clinicians. It could be inferred from the literature that the constraints, and anomolies, of the DRG model have encouraged clinicians to use activities, such as cost shifting, as pseudo funding mechanisms. If that is the case, the ability of DRGs to constrain costs, provide management benchmarks, and facilitate organisational performance is questionable.

3.5 The clinician's perspective of DRGs

While DRGs were introduced primarily as a mechanism to modify clinical practice, the impact of AN-DRGs on patterns of care in Australia is largely unknown at this time. In fact it may be difficult to determine the extent of the change attributable to AN-DRGs because of the incremental changes to health service provision that has been ongoing over recent years. Length of stay has been steadily declining in many hospitals, and beds closed. Day only procedures have been introduced, and community maintenance programs promoted. The effect has been to keep the pressure on occupancy rates and, some would believe, to erode the power of doctors to influence patterns of hospitalisation (Michael 1991; Degeling 1994).

Clinicians have voiced their concerns about prospective payment system (PPS) based on DRGs, primarily because of the perceived impact upon clinical care and resources. Specifically, the threat of decreased quality of care, and limited access to services as a consequence of reduced funding (Wennberg et al. 1984; Stern & Epstein, 1985; Viney et al. 1991), reluctance to treat potentially 'expensive' cases (Newhouse 1983), inability to explain variation in service provision (Michael 1991), incentives to code episodes of care to optimise reimbursement at the expense of epidemiological accuracy, (Hindle et al. 1991; Simborg 1981) and anomalies in ICD-9-CM codes (Iezzoni & Moskowitz 1986; Holman 1994), are examples of the concerns that are being discussed in the professional literature.

For many years surgeons have operated under a reimbursement system that is not unlike the DRG model (Gardner 1984). The cost to the patient, or the insurer, of the complete episode of care has been bundled to include the preoperative visits, procedure, and postoperative followup as a single cost item. Obstetricians also apply this payment system for the care of pregnant women. In comparison, the non surgical practitioner, who is reimbursed on the basis of each hospital visit, does not have the same incentive to discharge the patient. It has also been suggested, that a move to fixed payment for medical conditions will significantly reduce the use of specialty consultations (Gardner 1984).

The ability of hospitals to influence the economic and medical behaviour of physicians has been postulated as one consequence of DRGs. A potential convergence of interests between preservation of hospital resourses and clinical decision making has also been identified (Landgarten 1984). The integration of DRGs into the information system of hospitals will be less than optimal without the co-operation of medical practitioners. Therefore it is important that information about DRGs be provided to all health professionals involved in the development of AN-DRGs, and implementation of the system at hospital level (Landgarten 1984). However, this will require a long term strategy involving education and consultation.

Degeling, Black, Palmer & Walters (1995) investigated the level of knowledge about casemix amongst clinicians and hospital managers. Results demonstrated that while managers are marginally more knowledgeable than clinicians, neither group could demonstrate a level of understanding indicative of active participation in the implementation of DRGs into hospitals.

3.6 Unresolved issues

The concept of casemix funding is superior to the more traditional approach of reimbursement of the costs of inputs. The challenge is not to decide whether hospitals (or home care agencies, or rehabilitation units) should be funded according to their casemix-weighted volumes, but rather how to do this well.

Hindle (1996a) argues, that many criticisms result because of inadequate understanding of the nature of health care management problems. The criticisms are often compounded by failure to define the basis for evaluation. Dowie (1995), introduced the term "partial or non-comparative evaluation" or 'poncing' for this kind of approach. He was defending the use of the QALY against those who only partially evaluated QALYs and failed to apply the same rigour when considering the options. Poncing is also common in respect of casemix-based funding.

A simple example is the common method of funding of privately insured inpatients in Australian public hospitals, whereby billing is according to a daily rate which is the same for all patients. Thus the classes are "patients who stay one day"; "patients who stay two days"; and so on. Opponents of a change to billing on a per case basis by DRG, argue that the classes are less than homogeneous. They do not appear to have recognised that the current arrangements assign all patients who are in hospital for the same number of days to the same class, without regard to intensity (which may range from multiple procedures and intensive care for major trauma, to provision of no more than accommodation pending arrangement of post-discharge care). This example of classification by default occurs in the absence of classification systems that are based upon clinical and/or resource criteria.

Nevertheless, there are many opportunities for improvement. First, there is the potential to improve DRG logic. Australia changed its definition of principal diagnosis to the United States style in 1989 (from most resource-intensive to the condition most responsible for the decision to admit). There are some who would argue that the change was a mistake, and that, like Canada, DRG usage should have been modified instead.

An underlying problem is that the concept of principal diagnosis as used in the DRG context has little relevance to routine clinical practice. For example, patients are often admitted as a consequence of interactions between two or more conditions, none of which would be sufficient in itself to merit admission (Connell, Blide, & Hanken 1984; Roberts et al. 1985; Iezzoni & Moskowitz 1986; Reid 1988). While the reason to admit may will determine the resources consumed by patients who receive care for only one condition, the same cannot be assumed for patients who are treated for multiple disorders during an admission. Elderly patients, and those with chronic disorders for example, may be admitted as a result of a combination of diagnoses, which in isolation, would not warrant hospitalisation. The 'most appropriate' definition is contextual, and takes into account factors such the priorities of the group developing the definition, the characteristics of the patient population and the nature of the disorders being considered

However, the main concern is that the practice of selecting a single diagnosis may be illogical and unnecessary. A competitor of DRGs, Patient Management Categories, takes a more plausible approach (Hindle 1992). Each diagnosis is considered in turn by the assignment algorithm, but the order of listing is irrelevant. The first-listed is assigned to cluster 1. The next is either assigned to cluster 1 if it is associated with the first-listed diagnosis, and otherwise is assigned to cluster 2. This process continues until all diagnoses have been assigned. The result is a description of conditions as one or more clusters. They are in the same cluster if they are clinically associated, and therefore might expect to be treated in much the same way at little additional cost. On the other hand, the episode involving, for example, admission for a rectal resection where there was a post-operative myocardial infarction would result in definition of two distinct clusters. This is a more precise and informative description of the episode than is possible with DRG logic, where the case would be defined as rectal resection with CCs (Hindle 1992).

The DRG logic for assignment of surgical episodes also has inherent weaknesses. In most cases, only the most costly procedure is taken into account, and therefore episodes in which more than one procedure was performed are undervalued. Similarly, only one comorbidity or complication is taken into account, when one might assume that cases with multiple secondary conditions would tend to be more expensive to treat. Further there is no discrimination between comorbidities and complications when, in a funding context, there might be good reason to pay more for treatment of comorbid conditions, and less for complications where they are avoidable.

These issues are not matters of conjecture. In a recent analysis of South Australian data, Hindle and Halsall (1995), found that cases with multiple conditions and procedures had significantly longer lengths of stay than the mean for the DRGs to which they were assigned. One major teaching hospital had 11% longer lengths of stay which could be attributed to within-DRG variations associated with multiple conditions and interventions. In this instance this result was expected because, as a teaching hospital, it attracts more serious cases.

The effect was not present in data from a specialised paediatric hospital. This is clinically plausible because increased severity is more likely to be in the principal condition among children, whereas it is more commonly associated with comorbidities in the adult, and particularly, the elderly population (Phelan 1994b). However, another recent Australian study concluded that there were several weaknesses in DRG classification which led to unfair resourcing of specialised paediatric hospitals (Health Solutions 1993).

The findings were generally consistent with a United States study of the same type (Vertrees & Pollatsek 1993). The most important finding here is that not all principal diagnoses or procedures discriminate sufficiently for accurate

DRG assignment. Typical examples are DRG 774 (lymphoma and non-acute leukaemia), 780 (chemotherapy), 757 (reticuloendothelial and immunity disorders with non-major CCs), 533 (nutritional and miscellaneous metabolic disorders, age under 10 years), and 250 (circulatory disorder except acute myocardial infarction, with invasive cardiac investigative procedures).

Most of the high-loss DRGs concerned chronic conditions, where single diagnoses tend to be particularly uninformative. For example, there are around 240 ICD-9-CM diagnoses which result in assignment to DRG 774, and they vary considerably in their implications for intervention. None is sufficiently descriptive of the severity of illness at time of admission. In general, using the ICD-9-CM codes to describe the principal diagnosis alone is insufficient to provide meaningful data describing the episode of care. However, there is the potential for greater discrimination (for example, by use of computerised pathology systems) in future.

Two other weaknesses worth noting here, are being progressively resolved in Australia. First, the DRG classification groups together procedures which are consistently and appropriately different in costs. For example, under Commonwealth Medical Benefits Scheme (CMBS), the procedure classification used for private medical billing in Australia, identifies ICD-9-CM code 39709 (craniotomy for removal of tumour in cerebrum, cerebellum, or brain stem) and code 39712 (craniotomy for removal of intraventricular or intracranial tumor). Surgeons charge about twice as much for the latter. This is not entirely illogical because a recent study showed the mean theatre duration to be 54 minutes for 39709, and 112 minutes for 39712 (Archon Health Consultants 1993). In short, there is no obvious benefit to anyone in assigning these two procedures to the same DRG, and funding at the average.

Part of the underlying logic of casemix-based funding is that it should encourage substitution, or avoidance of resource use. For example, if funding is the same regardless of the number of pathology tests undertaken, there will be an additional financial incentive to avoid tests which are of low utility. However, this argument is of much less relevance to operating room procedures as they are rarely substitutable. Moreover, if they are avoided, they will generally result in assignment to a different DRG.

The general difficulty of severity discrimination is illustrated by intensive care. Consider DRG 132 (epiglottitis) which, in the 1992-93 Australian National DRG Costing Study had a mean cost of $3395, of which $1025 (or 30%) was defined to be associated with critical care (KPMG Peat Marwick 1994). This statistic is an average of patients whose intensive care unit costs were zero, and others who incurred costs of $5000 or more. The low frequency of occurrence and unpredictability of intensive care for this DRG is illustrated by the equivalent private hospital statistics: the mean total cost was $604, of which zero was attributed to intensive care.

While this is an unusual case, it does illustrate that large variations are common. Indeed, there are 300 DRGs where intensive care, as a proportion of total costs, differs by a factor of two or more between public and private hospitals. Some of the difference may be attributed to data errors, however, the main problem is simply that the need for intensive care is not effectively predicted by the DRG classification.

Attempts have been made to improve DRG performance with respect to severe illness. For example, classes for tracheostomy were added to the New York DRG variant in 1987, for the specific purpose of indicating patients who might be expected to be managed in an intensive care setting. In AN-DRG version 3, six classes are defined either by tracheostomy or ventilator support. Further refinement was, however, constrained by use of length of stay as the basis for appraisal of additional changes, as much of the additional cost of intensive care relates to intensity rather than duration of care.

The Australian Casemix Clinical Committee has concluded that AN-DRG version 3 is still not adequate in this regard, and has therefore recommended that intensive care be measured and funded "...outside the AN-DRG classification" (ACCC 1994b:19). This is a necessary interim measure, if hospitals with intensive care facilities are not to be consistently underfunded. However, the aim should be to enhance the DRG classification so that separate measurement is no longer necessary. For example, incorporation of selected variables from the Acute Physiology and Chronic Health Evaluation (APACHE) would be one means of discriminating between cases on the basis of resource consumption (Wagner & Draper 1984). The APACHE is a severity-of-illness classification system developed to describe groups of intensive care patients and evaluate their care. The acute physiological score component of the APACHE, has been demonstrated to effectively explain variation in survival and resource consumption by intensive care patients.

There are many other opportunities for improvement. For example, it appears that all DRG variants would handle same-day admissions more effectively if the balance of procedural, to medical classes were changed in favour of the former, and if additional procedures were taken into account. The handling of social and economic problems also merits attention. Although hospitals in Australia, as is the case in many other countries, deliberately and appropriately take account of factors such as child abuse and homelessness, these kinds of measures of condition have no effect on DRG assignment.

3.7 Summary

The health care industry is responding to the challenges that come from the need to provide services, in an environment of ongoing cost-constraint and rationalisation. Funders and providers of services have responded, by introducing strategies that are designed to transform the operations of hospitals, and to achieve maximum efficiency and effectiveness. However, caution has been expressed about the ability of the reforms to achieve their goals of rationalised health care, without compromised services.

Particular attention has focused on the use of casemix information to support funding models, service evaluation studies and quality assurance activities. While elements of information are common to these applications, each has data requirements that are unique to, and specific for, their stated aims. For example, some of the data elements that describe the cost of providing care, can also be used to describe the outcomes of care. However, each application also requires specific data to ensure sensitivity and reliability. It may not be possible to expect one classification to be specific, sensitive, reliable, and valid for multiple applications. The fact that the AN-DRG classification has been applied to a diversity of data needs, may in fact, reduce its validity and reliability for all applications.

Society has deeply institutionalised expectations about the type of health services that are provided, and an individual's ability to gain access according to perceived needs. The introduction of PPS to fund hospitals according to the casemix, is being encouraged by supporters of the system, who are primarily the funders, and cautiously and suspiciously observed by clinicians and users of services. However, it is important to recognise that simple models are likely to deliver only marginal and short-terms gains at best.

Many countries have increased the cost/effectiveness of their health care systems by the application of more sophisticated measures of casemix to the funding process. There is a systems principle, which states that the complexity of the management system should be commensurate with the complexity of the production system. There are few enterprises as complicated as healthcare.

Casemix funding is an essential component of resource allocation formulas. However, it must be done well if the benefits are to exceed the costs. Moreover, it does not replace much of what is sensible about the existing healthcare delivery system nor obviate the need for other kinds of innovations. If the benefits are to be realised, we must abandon the view that there is a simple answer.

It is impossible to solve all the problems overnight. However, the rate of change can be increased if development responsibilities are shared; and particularly if there is a high degree of clinician involvement. In this regard, it would be helpful if there was a greater degree of overt recognition of some of the legitimate criticisms than has been the case in some parts of the world. Much of the concern has arisen from the tendency to present casemix funding as the final answer, rather than a positive step in the right direction which will need, and will in fact receive, continual enhancement.

CHAPTER 4

CODING ISSUES IN A DRG CONTEXT

DEVELOPMENT AND USE OF CODING GUIDELINES

GUIDELINES FOR SELECTING PRINCIPAL DIAGNOSIS OR PROCEDURE

PROBLEMS WITH SELECTION OF PRINCIPAL DIAGNOSIS OR PROCEDURE

CODING OF COMORBIDITIES AND COMPLICATIONS

THE IMPACT OF INACCURATE DATA

INHERENT PROBLEMS WITH THE CODING SYSTEM

SOFTWARE FOR AN-DRG ASSIGNMENT

QUALITY ASSURANCE FOR THE DRG SYSTEM

SUMMARY

Chapter 4 Coding issues in a DRG context

This chapter describes the principles of DRG assignment from a coding perspective and addresses coding issues identified in the literature. The efficiency of coding of information according to standardised protocols and guidelines has a major impact on the effectiveness of the classification for research, management and financial purposes. The potential of DRGs to enable comparison, aggregation and analysis of inpatient data within, and between hospitals, was seen as a strength of the classification. However, the development of large datasets that can be used for these purposes requires both appropriate computer software, and quality data. Although assessment of the accuracy of coding was not a primary aim of this research, the accuracy and completeness of the coded data, and coding practices and guidelines, will influence the findings of the study.

Researchers have identified problems with coding protocols and guidelines for DRG assignment. The completeness of the clinical data, selection of the principal diagnosis, accuracy of coded data, methods of detecting coding errors, accuracy and totality of individual codes and DRG creep, have been raised as concerns and will be discussed in this Chapter.

There are two types of data errors that limit the usefulness of DRGs: lack of precision and lack of accuracy (McGuire 1993). Precision refers to the ability of the coding system to identify subtle differences between patients with the same disease, and between those who receive similar treatments. Lack of precision reduces the homogeneity of the resulting groups. Accuracy depends upon documentation that appropriately reflects the ability of the coding system to account for differences between patients.

The inability of the DRG system to capture data describing secondary diagnoses, and the implications of that for funding, research and morbidity and mortality data, has also been raised as issues. While some degree of uncertainty is to be expected in any casemix system, the inability of AN-DRGs to account for all of the resources used to treat a patient, is a weakness in the design that will have financial implications for providers of services now that this data is being used as one component of the funding formulas for hospitals in a majority of Australian States.

4.1 Development and use of coding guidelines

An episode of care is assigned to a DRG according to the schema described in Chapter 1. To support this process, guidelines and protocols have been developed incrementally as the system has been refined. These guidelines are usually initiated by clinicians, who approach the task with extensive clinical knowledge. As a result, guidelines are embedded in the clinical context. However, the instincts and intuition that develop from years of clinical decision making, cannot be represented by a guideline. The complexity of health care, and variation of clinical decisions between practitioners, further limits the ability of guidelines to cover all clinical situations.

A recent directive to coders regarding diabetes demonstrates how data quality can be compromised by the coder/clinician gap. Coders have been directed to assume that a patient with Non-Insulin Dependent Diabetes (NIDDM), admitted and treated with insulin, is uncontrolled (National Coding Centre 1995a). In a clinical sense, the directive to associate uncontrolled diabetes with insulin therapy complicates, rather than clarifies, the situation. In the diabetes context, control refers to the person's ability to maintain their blood glucose level (BGL) within the range of 4-10 mmol/l. Diabetes is described as 'uncontrolled' when the BGL is frequently outside this range.

Insulin is the treatment of choice for 30% of people with NIDDM, and as a result their BGL remains at a clinically acceptable level. Commencing a patient onto insulin is a clinical decision that is frequently made in situations where the patient is at risk of experiencing uncontrolled diabetes. Diabetes control can be compromised by infection, surgery and stress. Commencing a patient temporarily on insulin as a prophylactic measure, may in fact maintain the blood glucose levels within an acceptable range, and prevent the diabetes becoming uncontrolled. Interestingly neither the cost weight, nor the assignment of the episode of care, is influenced by the level of control of the patient. A patient with uncontrolled diabetes as a secondary diagnosis, will be assigned to a DRG without CCs. Additional resources required to manage the disorder, will include consultations with a physician, dietitian and diabetes educator and laboratory analysis, which may be extensive if the cause of the high BGL is not easily identified. This is an illustration of the weakness of a patient classification system based primarily upon the principal reason for admission. The resources that are used to manage secondary diagnosis are significant, although largely ignored.

Second, the guideline does not provide sufficient information to enable a coder to discriminate between the clinical characteristics of patients using insulin. This guideline could equally refer to a patient with NIDDM who is admitted to hospital and subsequently commenced on insulin therapy, or a patient with NIDDM treated with insulin prior to hospitalisation. The patient who has been commenced on insulin and educated about insulin therapy prior to admission, may require considerably fewer resources than a patient who is commenced on insulin during the admission.

There is evidence to suggest that clinical documentation that is sufficiently detailed to enable coders to apply guidelines according to individual characteristics of patients, is rarely found in the records (Currie 1985). The treating medical officer is responsible for recording the diagnosis and procedures on the patient summary sheet following discharge of the patient. The principal diagnosis is identified, and secondary diagnoses (CCs) listed. The principal diagnosis in Australia, as defined in Chapter 1, is the condition responsible for admission to hospital.

Only one diagnosis may be identified as the principal diagnosis. All conditions that existed at the time of admission to hospital, developed during hospitalisation, or influenced the patient's treatment and/or length of stay by greater than one day, should be listed as CCs. Up to 20 CCs may be listed on the discharge summary, however, only the highest ranking CC will influence DRG assignment. For the purposes of DRG assignment by the grouper software, lists of CCs have been identified and ranked for each DRG. The PC grouper recognises the principal diagnosis and, when CCs are listed, selects the highest ranking CC; all other CCs are then ignored.

Only those diagnoses that require treatment, and therefore influence the resources that are used during the current admission, by for example, requiring clinical evaluation, therapeutic treatment, diagnostic procedures, extended length of stay and increased nursing care and/or monitoring, should be listed for coding. All diagnoses listed for coding must be documented in the medical record. In addition, any conditions that were present at the time of admission and have a bearing on the management, for example blindness, should be listed for coding (South Australian Health Commission 1992). However, as has been demonstrated, the inclusion of information describing secondary diagnoses may not influence assignment of the episode of care.

Clinicians are generally not aware of the relationship between detailed, accurate clinical documentation and quality DRG data. A recent survey of 1,970 staff from 58 hospitals in Australia demonstrated a low level of knowledge about casemix, in fact 224 of the staff selected to participate, believed that they had insufficient knowledge to complete the interview (Degeling et al. 1995).

Management staff generally had more knowledge, and a more positive attitude towards casemix, than did the clinicians who, at best, were ambivalent towards the introduction of DRGs, and in many instances antagonistic, towards their structure. The study also demonstrated that less than 50% of staff had participated in education activities regarding DRGs or casemix. These findings are of concern given the role of clinicians in the preparation of records, and must cast doubts on the accuracy of the raw data for coding and ultimately, DRG assignment. Further, the findings of this report are also cause for concern given the increasing incorporation of the DRG model into clinical and management aspects of hospitals.

4.2 Guidelines for selecting principal diagnosis or procedure

The guidelines developed for assignment of cases to AN-DRGs have been designed to reflect clinical practice and, to a lesser extent, healthcare policy in Australia. The guiding principles for the selection of the principal diagnosis and procedure are discussed below, followed by a review of research identifing problems with how the principals should be, or are applied.

4.2.1 Guidelines for Principal Diagnosis

The Australian standard definition for principal diagnosis is "...the diagnosis established after study to be chiefly responsible for occasioning the patient's episode of care in hospital" (National Health Data Committee 1995:3-82). Coding guidelines also direct that "...symptoms, signs and ill-defined conditions should not be recorded as the principal diagnosis when the underlying cause has been diagnosed" (South Australian Health Commission 1992:13). However, this directive can be set aside in circumstances that preclude identification of another principal diagnosis, or if management of the symptom warrants special treatment or care. In cases where there are multiple diagnoses, the guidelines define the principal diagnosis as the one requiring the most intensive utilisation of resources, or the condition for which a definitive surgical or non-surgical procedure was performed. In practical terms, the identified principal diagnosis may not be the condition that required the most intensive treatment during the admission.

While complications that develop after admission are not considered to be a principal diagnosis, in those cases where the admission is for treatment of complications arising from another condition, the complication may correctly be identified as the principal diagnosis (South Australian Health Commission 1992). For example, if a patient is admitted for treatment of gangrene resulting from diabetes, gangrene is the principal diagnosis, and diabetes is identified as a secondary diagnosis. In those instances where the medical officer records conditions as being the probable, suspected, or the likely cause for admission, coders are directed to state the condition as if it was established. This practice has been adopted to account for the resources used to treat the patient; for example, a patient admitted with suspected myocardial infarction receives similar management to a patient admitted with the condition confirmed. While this is the accepted practise, the accuracy of the data from morbidity research must be questioned (Mullin 1985).

Where a patient has both an acute and a chronic condition, the acute condition is identified as the principal diagnosis, and the chronic condition as a complication/other condition. In cases where treatment planned prior to admission was not carried out during the admission, the incomplete treatment is identified as the principal diagnosis reflecting the 'reason for admission' component of the definition of principal diagnosis (South Australian Health Commission 1992).

The definition is somewhat clearer in cases of multiple injury; the most severe injury is considered to be the principal reason for admission. However, whether severity is defined in clinical or resource intensive terms could be open to interpretation. In the case of multiple burns, the highest degree of burn is recorded as the principal diagnosis.

4.2.2 Guidelines for Procedures

The definition of a Principal Procedure is provided in Chapter 1. All significant procedures, both diagnostic and therapeutic, that are undertaken during the admission need to be listed. A significant procedure includes treatments broadly defined as surgery, as well as procedures that carry a procedural or an anaesthetic risk, or require special facilities or equipment available only in an acute care setting (South Australian Health Commission 1992). In those instances where multiple procedures were carried out, the procedure used for treatment, rather than diagnosis, is considered to be the principal procedure.

A principal diagnosis is not required to be selected for surgical patients because the grouping software evaluates all procedures according to a hierarchy. Up to 10 procedures may be listed, and while the sequencing of procedures does not affect DRG allocation, the information is important for morbidity data.

4.3 Problems of selection of principal diagnosis or procedure

While the technology now exists to analyse extensive hospital discharge data bases, the design of DRGs, and the coding guidelines, have unwittingly resulted in conceptual problems which militate against the diagnostic accuracy of discharge data. An example of the outstanding difficulties is the definition of principal diagnosis, which plays a crucial role in categorisation by DRG.

Clinicians have noted that the concept of principal diagnosis as used in the DRG context has little clinical meaning for the reasons previously discussed

(Phillips 1994; Pilla 1994). Inconsistent application of the definition further reduces the usefulness of the resulting data (Connell et al. 1984; Lloyd & Rissing 1985).

The difficulties associated with classifying a hospital admission by a single disease code, according to the principal diagnosis or principal procedure, has been recognised as a cause of inaccurately coded data (Connell et al. 1984; Roberts et al. 1985; Mullin 1985). Clinician and coder error are also recognised to be causes of precision (Connell et al 1984; Lloyd & Rissing 1985). Both types of problems can lead to inappropriate DRG assignment.

Patients are often admitted as a consequence of interactions between two or more conditions, which in isolation would not warrent admission. This situation is not uncommon for admissions attributable to diabetes, which often involve multiple complications. Elderly patients with multiple conditions are similarly placed. The requirement for a single admission poses particular difficulties with coding of complex medical conditions (Connell et al. 1984), although the potential for more than one valid principal diagnosis is low in booked surgical admissions (Roberts, Reid & Irwin 1985). The situation is a particular problem when clinicians fail to select a principal diagnosis and the responsibility falls by default to the coder (Reid 1988).

Common errors in clinical documentation that affect DRG assignment have been identified to be:

- failure of the clinician to identify a principal diagnosis;
- incorrect sequencing of the principal diagnosis on the discharge summary;
- incorrect coding of the principal diagnosis (incorrect ICD-9-CM code assigned);
- other diagnoses that affect DRG assignment not coded.

(Roberts et al. 1985; Currie 1985; Reid 1988; Donoghue 1992)

The potential for data abuse to distort the casemix profile of the hospital has been discussed in the literature. Using DRG discharge data as a basis for propsective payments to healthcare facilities, provides an incentive to code episodes to optimise payments. DRG creep is described as "...deliberate and systematic shift in a hospital's reported case mix in order to improve reimbursement" (Simborg 1981:602). While the potential for DRG creep, or gaming, is recognised, the extent of this problem is unknown largely.

4.4 Coding of comorbidities and complications

Data describing the nature and frequency of co-existing conditions, needs to be collected, and analysed, to ensure that DRG data accurately describes the resources used. Without a comprehensive dataset, estimations of resource consumption, patterns of current health care provision, and predictions about future health care needs, cannot be determined with any degree of accuracy.

The importance of recording secondary diagnoses has been raised by Iezzoni et al. (1992). One cause of concern for these authors, is the potential for chronic disorders to be excluded from the list of secondary diagnoses, particularly for those patients with multiple conditions. The possibility of coding bias towards acute care at the expense of chronic disorders, reduces the usefulness of the DRG data for epidemiological research and morbidity and mortality data.

Results of research undertaken by Iezzoni et al. (1992) indicate that patients with a secondary diagnosis of diabetes mellitus, and cardiac conditions including unclassified arrhythmias, old myocardial infarction, ischaemic heart disease and hypertensive heart disease, were less likely to die within 30 days of discharge from hospital. These researchers postulated that this situation results from recording bias which reduces the likelihood of chronic disorders being reported if the patient dies. In addition, limitations on the number of secondary diagnoses recorded is likely to truncate chronic disorders from the diagnosis list.

As a result, these researchers recommend increased attention by clinicians to accurately record secondary diagnoses, and attention to their recorded order to ensure the most significant disorders are sequenced early in the list. This could be achieved by requesting that clinicians prioritise secondary diagnoses, and requiring coders to apply that ranking as codes are entered onto the computer. The grouper software would also need modification to accommodate the ranking.

4.5 The impact of inaccurate data

The high frequency of errors identified in recoding studies has caused researchers to question the validity of DRG data (Lloyd & Rissing 1985; Reid 1988; Iezzoni et al. 1992; Donoghue 1992). Ensuring data accuracy is an urgent priority for health administrators now that data are used as a component of the resource allocation formula for hospitals.

Clinicians and coders have been shown to contribute to poor data quality. As would be expected, studies undertaken early in the development of the DRG system demonstrated high error rates (Doremus & Michenzi 1983; Lloyd & Rissing 1985; Reid 1988). However, a decade later, improvement has not been as marked as one would expect (Donoghue 1992; Holman 1994).

The impact of errors upon DRG assignment varies. Doremus and Michenzi (1983) found that using patient data obtained from HCFA would result in a significantly understated level of Medicare reimbursement for University Hospitals in one State in America. Currie (1985), demonstrated a 2.6% change in DRG assignment resulting from incorrectly sequenced principal diagnosis, while Donoghue (1992), found a 9.25% change in DRG assignment, largely due to inaccurate or incomplete clinical documentation.

While the impact upon revenue varies, the result has been an underestimation of costs by the hospitals (Currie 1985; Donoghue 1992).

Holman (1994) investigated the impact of casemix upon work practices at a paediatric teaching hospital in Sydney, Australia. Responses demonstrated two areas of deficiency; clinicians had little understanding of casemix, and second, the quality and timeliness of coding was below expectations. These procedural problems were addressed by introducing a Total Quality Management (TQM) program, which included redesigning facilities on the wards, to enable Resident Medical Officers to complete discharge summaries and sign test results with minimum disruption to other activities. The discharge summary form was redesigned, and guidelines for the completion of discharge summaries and test results were developed and implemented throughout the hospital. To provide information about coding requirements, a pocket sized folder containing information and requirements was distributed to all medical officers (Holman 1994).

Accurate clinical documentation is a fundamental requirement for quality DRG data. It is the responsibility of the clinician to ensure that the principal diagnosis is correct, and that all other conditions and complications that influence the management of the patient during hospitalisation are listed. While coders are expected to peruse the medical record, in order to meet the New South Wales Teaching Hospital Industry Standard of 11 records per hour (Donoghue 1992), there is limited time to study each record in detail. This time constraint could contribute to the coding errors that have been identified in coding studies.

A retrospective study of a sample of 4000 records from three large Sydney teaching hospitals, was conducted to identify the specific errors and problems related to medical record documentation and coding (Donoghue 1992). The principal diagnosis, all secondary diagnoses, principal procedure, and all other procedures were reviewed for each record by coders who were blinded to the original coding. Each digit in all codes was required to agree, otherwise an error was recorded. Results demonstrated a 60% aggregated error rate for the three sites, however, when minor errors were removed, the error rate was reduced to 47%.

Errors were classified as ambiguous principal diagnosis, terminology not consistent with the ICD-9-CM, incorrect sequencing, use of other and unspecified codes due to lack of detail in the medical record, unclear or inconsistent documentation, clerical error, coding rules not followed, and missing codes. The most common errors were found to be inconsistent and unclear documentation, and incomplete coding of the episode of care. The average number of errors per record from the three sites was 1.3, resulting in a DRG change in 9% of records, 36% of which favoured the participating hospitals. From this data, the researchers postulated that the hospitals would have gained an additional two million dollars from the correction of errors and subsequent changes in DRG assignment.

Lloyd and Rissing (1985) reviewed 1829 medical records identified from the discharge abstract system of the Veterans' Administration. Eighty two percent of the records differed from the abstract in at least one item attributable to physician (62%), coding (35%), and keypunch (3%) errors. The average abstract was projected to contain 2.14 physician and 0.81 coding errors. Eighty-nine percent of projected physician errors were identified as incomplete coding of procedures (46%), or diagnoses (54%). The majority of coding errors were incorrect decisions about what to code rather than an incorrect code, with non-operating room procedures frequently not coded. The results indicated that correction of errors would result in a DRG change in 19% of episodes, and substantially increase reimbursement.

In the United Kingdom, Williams (1985) studied the clinical records of patients who were known to have diabetes and admitted to one of three hospitals in London, Cambridge or Newcastle. Diabetes was not noted as either a principal or secondary diagnosis in 201 (27%) of the total admissions examined. Although diabetes was considered to be the principal diagnosis in 315 admissions, it was documented in 283 (90%) of these records. Diabetes was mentioned in only 48% of surgical admissions and was more likely to be noted when the admission was associated with another condition, for example, management of diabetes related complications. In this study, the errors were largely due to clinician failure to accurately record all conditions on the discharge summary.

Reid (1991) undertook a study to determine the effect of coding on the allocation of DRGs in Australia. Reid concluded that overall, the quality of the coded data was adequate for the DRG system to be used in Australia, however resolution of problems related to the secondary diagnoses, and implementation of standardised coding policies, would improve the accuracy, and thereby the usefulness of the data.

4.6 Inherent problems with the coding systems

A general criticism of the DRG system, which applies to both medical (Wood et al. 1985) and surgical patients (Smits & Watson 1984), is the inclusion within a single DRG of patients who are dissimilar clinically, and have considerable variation in length of stay. This situation is, in part, a result of the requirement to group all diseases, types of patients, and treatment regimens into a manageable number of groups. For example, a patient aged 35 years recently diagnosed as having IDDM, has different clinical requirements to a patient aged 35 years who has had IDDM since early childhood and is receiving treatment for eye and renal complications.

Problems with the ICD-9-CM classification have also been identified. Holman (1994) referred to the outdated terminology used in the classification, and the limitations this poses upon good documentation. The fact that the ICD was originally designed to group diseases and not patients, has also been identified as a problem (Iezzoni & Moskowitz 1986). The ICD was first developed in the 1880s for the purposes of statistical analysis and coding the cause of death. While the clinical modifications (CM) have been an attempt to move away from the emphasis upon grouping diseases according to anatomical sites, the nature of the additional details, which include health problems, symptoms, clinical events, physical findings and severity indicators, have inherent difficulties that have been implicated as sources of imprecision with the DRGs (Iezzoni & Moskowitz, 1986). In fact, the suitability of the ICD-9-CM as a basis for classifications such as DRGs has been questioned (Holman 1994).

As a consequence of the inclusion of DRG data in the funding formulas for Australian hospitals, coding decisions have taken on a significance that extends beyond service planning and research. Coding guidelines and practices have become health policy issues, where decisions can have a multi-million dollar effect upon the health budget. The impact of coding practices upon the cost of health care has been recognised for some time in America (Smits & Watson 1984) and will become increasingly important in Australia.

McGuire (1993) compared DRG data from all Australian States and Territories to determine the degree of concordance between regional health care datasets. The variability of the source data reflected the influence of organisational and financal policy upon individual datasets. In this study, the Northern Territory had assigned patients to 274 AN-DRGs, while South

Australian and Victoria had assigned patients, which in many cases were clinically similar to patients in the Northern Territory, to 515 AN-DRGs. The source of the errors was found to be the inclusion of incorrect procedure and diagnosis codes in the Northern Territory dataset which prevented correct assignment.

Funding models based upon casemix have been found to explain about 70% of the resource variation across hospitals (McGuire 1993). Using a dataset of one million patient records, McGuire demonstrated the difficulties of developing a classification system capable of explaining all variations in LOS. In that study, records were allocated to one of 48 groups based on the MDCs and the presence of an operating theatre procedure. Only 7% of the variation in LOS was explained by assignment to these groups. The percentage reduction in variance (%RIV) increased to 76% when the records were reallocated to one of 700 groups based upon the DRGs.

In a PPS, a gap between reimbursement and the cost incurred in providing care would result in efficiency measures, and the necessity for ongoing supplementation to prevent a negative effect upon the health care system (Stoelwinder 1990). The challenge this creates for those involved in the design of casemix classifications in Australia, is to identify structures that yield the greatest gain in predictive ability, while maintaining a manageable number of classes.

4.7 Software for AN-DRG assignment

While the process of DRG assignment could be managed through reference to a manual, the only practical approach is to use computer software. Australian users currently have access to suitable software, which is provided by the American company 3M Health Information Systems. In addition to capabilities for grouping to the current AN-DRG version by input of the current version of ICD codes, the software allows other versions of DRGs and ICD codes to be used.

There is also the capability of obtaining access to other variants. For example, it is possible to access the All Patient Refined DRGs Grouper (APRDRGs), which has the distinctive capability of allowing 3 or 4 severity levels to be identified for complications, and comorbidities (Reid 1991; ACCC 1994b).

The value of easy access to DRG grouper software is appreciable in terms of management of data quality. For example, there are many types of error and edit messages which point to potential problems in abstraction, sequencing, and code assignment.

There are also some related software routines which can support the management of data quality and the efficiency of coding in general. In particular, there are software packages which facilitate the location of ICD codes from clinicians' narratives.

It should be recognised, however, that the cost and effectiveness of these kinds of software are less than they should have been. It is difficult to defend the Commonwealth's decision to employ 3M as the sole source of DRG grouper software, in that there has been no competition to encourage satisfactory performance. It is also the case that, because of difficulties in accessing the DRG grouper routines, Australian hospitals and software companies have been reluctant to develop add-on applications such as ICD code-finding and utilisation review software.

4.8 Quality assurance for the DRG system

A variety of strategies have been implemented in Australia to ensure quality casemix data, and facilitate ongoing research.

First, there is the National Coding Centre, which was established in December 1993 by the School of Health Information Management, University of Sydney. The Centre is funded by the Commonwealth Department of Human Services and Health, and has the following main responsibilities to:

- develop new codes to reflect Australian clinical practice;
- improve standards relating to the application of codes;
- develop and implement coding education programs;
- produce publications relating to coding; and
- undertake data quality management.

(Galbraith 1995a).

Second, the Clinical Coder's Society of Australia is in the early stages of development. The Establishment Committee was formed in mid-1995 with representatives from all States and Territories, the National Coding Centre, and the Health Information Management Association of Australia (National Coding Centre 1995a).

The formation of this Society will be a significant step towards coders achieving recognition of the unique skills and knowledge required to effectively perform their work. The Society will enable coders to develop a career structure based upon demonstrated coding expertise and knowledge, with associated pay scales, and ongoing professional development and review. Accreditation of coders will then be possible.

Third, the Australian Council of Healthcare Standards (ACHS) reviews Medical Records Departments as one component of the accreditation procedure for hospitals (Rotem 1991). Standards describe the minimum documentation acceptable in medical records, and requirements for the organisation of the medical record service.

Analysis of recommendations from the ACHS surveys of hospitals, indicates that the content of medical records is a major problem, with significant omissions observed in medical documentation. Of those hospitals that have difficulty complying with the standard, the most common problem is incomplete clinical information. Of the 215 hospitals surveyed between 1987 and 1990, 23% of the Medical Record Departments did not substantially comply with the standards. This compares to a non-compliance rate of under 10% of other Departments within the hospitals.

Holt and Anderson (1992) studied 109 of the hospitals that had received recommendations for improvements within the Medical Records Department when surveyed by the ACHS. These hospitals represented 80% of the total 139 surveys undertaken in 1990. Twenty two percent of the hospitals had admission diagnoses missing from records, and in 33% of discharge summaries were missing. In 17% of hospitals the front sheet, which contains significant demographic data, was not complete. The majority of hospitals had taken actions to implement recommendations from previous surveys, however, content remained a problem primarily because clinicians had failed to adequately complete documentation.

Since the Standards were last reviewed in 1986, the demands upon, and for, healthcare information have changed, largely as a result of the advances computer software technology has brought to health information systems (Anderson 1992). The ability to manipulate large computer databases has created opportunities for analysis of healthcare data not possible a decade ago. There has also been significant developments in coding and casemix analysis. These changes have implications for resources, utilisation review and healthcare funding and planning. The current review of Standards for Medical Records Departments will reflect these changes and take into account the additional demands for information created by DRG reimbursement (Rotem 1991).

The fourth agency is the Health Information Management Association of Australia (HIMAA), which was established in 1955 as the Australian Federation of Medical Record Librarians (Galbraith 1995b). The Association is the peak body representing health information managers in Australia and State branch associations have been established in all States and Territories with the exception of the Northern Territory.

A variety of projects have been established by the group to ensure quality health information is generated. An Education Committee was established in 1991 to advise on issues relating to the education and training of health information managers, including monitoring the content of undergraduate courses in Health Information Management. In conjunction with the South Australian Health Commission, HIMAA has published a booklet titled 'Coding and DRGs - A Handbook for Clinical Staff' (South Australian Health Commission 1992). A Distance Education Program, offering certificate level courses in medical terminology and clinical classification was established in 1992.

The National Coder Workforce Issues Project, funded by the then Commonwealth Department of Human Services and Health, is also managed by HIMAA. The project, commenced in mid 1994, is focusing on strategies to advance coder competency with the goal of introducing a system for coder accreditation in Australia (Galbraith 1995b).

4.9 Summary

Since the early 1980s researchers have been evaluating the ability of DRGs to accurately group episodes of care into clinical homogeneous and iso-resource groups. In the main, the results have demonstrated weaknesses in the DRG logic and assignment guidelines that have caused some researchers to doubt the effectiveness of the classification. Nevertheless, the DRG classification does have Government support (Duckett 1995).

One explanation for this divergence of expert opinion has been presented by Hindle et al. (1991). That author concludes that homogeneity can be based on a variety of attributes. If homogeneity is sought for the purposes of payment, then classification would be based on the cost of patient episodes. Classification according to clinical characteristics would be used if outcomes (quality assurance) are to be measured. Length of Stay could be the basis for classification based upon costs and clinical complexity. Reid's (1991) conclusion that DRGs are adequate for use in Australia, may have been made after consideration of the the 'best fit' for a diversity of applications rather than seeking a perfect correlation for one application. That conclusion is important, and must not be overlooked in the desire to create a classification with high specificity, but limited applicability.

Nevertheless, data that achieves optimal accuracy is important, and the analytical power of current computer technology allows manipulation of datasets to produce increasingly precise, and sophisticated classifications. Therefore it is important that coding policies and practices are undergoing continual refinement to achieve high levels of reliability and validity. Ongoing education for clinicians and coders will also be necessary to ensure uniformly high standards that result in quality data. The validity of the assumptions made from a sample, are a reflection of the accuracy of the data.

There are aspects of the DRG logic that do need to be addressed, particularly as applied to chronic conditions. Problems with identification of one principal diagnosis, the inability to consider the effect for all secondary diagnoses upon resource utilisation, and lack of specificity found in some DRG classes have been identified.

A variety of casemix classifications have been developed, or are in the process of development. Given the weaknesses identified in DRG logic when it is applied to the entire population of inpatients, it is reasonable to suggest that other classifications should at least be tested. Potential classifications need to be tested, using subgroups of inpatients, to determine whether they are capable of creating groupings with improved performance from both a statistical and clinical perspective compared to DRGs.

CHAPTER 5

DRG ASSIGNMENT AND DIABETES MELLITUS

SIGNIFICANCE OF DIABETES MELLITUS

DRG ASSIGNMENT PROBLEMS FOR CHRONIC DISORDERS

DRG ASSIGNMENT ISSUES AND AND DIABETES

SUMMARY

Chapter 5 DRG assignment and diabetes mellitus

This chapter focuses on issues related to DRG assignment of episodes of inpatient care for people with diabetes. The significance and nature of Diabetes Mellitus (DM) is presented and issues regarding DRG assignment for chronic disorders discussed in general terms. Attention is given to specific problems that have been identified with DRG assignment of episodes of care associated with diabetes.

5.1 Significance of diabetes mellitus

Diabetes Mellitus is one of the world's major public health problems. Diabetes Australia estimates that 0.5 million Australians are currently affected and that the number will increase to over 1.2 million by the year 2000. The increasing incidence is largely due to public awareness and screening campaigns supported by diabetes bodies and pharmaceutical companies in Australia. The incidence of diagnosis of diabetes in Australia is estimated to be 42000 per annum or four new cases each hour (Diabetes Australia 1988).

The two common forms of diabetes in Australia are insulin dependent diabetes mellitus (IDDM) and non-insulin dependent diabetes mellitus (NIDDM). The common complications of both IDDM and NIDDM include microvascular and macrovascular disease and neuropathy. Microvascular disease causes blindness and kidney failure leading to the need for dialysis and/or transplantation. Macrovascular disease is associated with accelerated atherosclerotic vascular disease causing heart attack, stroke and gangrene of the legs and feet. Neuropathy, which causes loss of sensation in feet and hands, has been estimated to be presented in 8% of newly diagnosed diabetic cases. An estimated 60% of people who have had diabetes for more than 20 years will have this complication. The majority of people diagnosed with DM will develop signs of one or more of these complications within five years of diagnosis (American Diabetes Association 1993; McCarty, Zimmet, Dalton, Segal & Welborn 1996).

Diabetes has been identified as the fifth most common cause of death in Australia (Diabetes Australia 1988). However, this statistic underestimates the overall impact of the disease. Heart attack and stroke, the first and third most common causes of death, are frequent complications of the condition. Therefore it follows that many more deaths than those recorded are probably attributable to diabetes.

The annual cost of diabetes to Australia is estimated to be in excess of $1.3 billion. Hospital costs account for $650 million of the total amount, of which $272 million is directly attributed to inpatient costs (McCarty et al. 1996). A recent study in the United States of America estimated that in 1992, the per-capita annual cost of hospitalisation for people with diabetes was US$11,157 which is more than four times the mean cost of patients without diabetes. The 4.5% of the population of the United States with diabetes accounted for

14.6% of the total healthcare expenditure of US$105 billion (Rubin, Altman & Mendelson 1994).

Length of stay has also been found to be increased in patients for whom diabetes is noted as a secondary diagnosis (Williams 1985). In that study, people with diabetes used on an average, 5.1 bed days per person per year compared with 1.1 days for the non-diabetic population. On an average day, 5.6% of beds were occupied by people with diabetes. When the rate of hospitalisation for people with diabetes as a secondary diagnosis was compared to people with diabetes as a principal diagnosis, those with diabetes as a secondary diagnosis accounted for 2.6 times as many bed days as those with diabetes recorded as the principal diagnosis.

Given the extent of resources used to manage diabetes, it is not surprising that funders and providers of services are investigating information systems for collecting and retrieving data in a format that is manageable, generalisable and effective. However, an underlying difficulty, regardless of classification design, is the high level of clinical diversity among patients with diabetes. Some patients will be newly diagnosed, while others will have developed one or more complications that will cause varying degrees of incapacity up to that which requires intensive care. Some will have diabetes noted as the principal diagnosis, while a clinically similar person may be admitted as a result of a complication and have diabetes noted as a secondary diagnosis. In some instances diabetes may not be coded at all.

Australian casemix data provides relatively little indication of the magnitude of the problem. The 1992-1993 National DRG Costing Study provides data only for inpatients for whom diabetes was the principal diagnosis, and where assignment was to one of two DRGs exclusively reserved for diabetes (KPMG Peat Marwick 1994). The relevant statistics are as shown in Table 5-1.

According to the data, AN-DRGs 529 (Diabetes, age > 35 years) and 530 (Diabetes, age < 36 years) represent about 0.5% of the total inpatient workload of all Australian acute care hospitals. If this were the only cost, it is understandable that diabetes has been given little attention in the context of DRG refinement. There is, however, good reason to believe that the cost of treatment of diabetes defined as a secondary condition is many times higher.

While no Australian study has attempted to estimate the incidence of admission by all people with diabetes, studies have investigated patterns of health service utilization by people with IDDM. Sutton, Lyle & Pierce (1989) estimated that 241/268 (90%) of newly diagnosed diabetics attending the Camperdown Children's Hospital Sydney, between April 1985 and December 1987 were admitted at the time of diagnosis. Almost all these patients were readmitted during the 12 months following diagnosis for treatment of diabetes The average LOS on both occasions was 11 days.

Table 5-1 : cost data for DRGs 529 and 530, National Costing Project

Please see print copy for image

(Adapted from KPMG Peat Marwick 1994)

In New Zealand, Scott, Brown & Clifford (1985) found that over a ten month period, there were 274 admissions by 197 diabetic patients contributing to 3.6% of the total hospital admissions. The average LOS was 13.6 days compared to 11.3 days for non diabetic patients.

Information is also available about the use of hospital services by people with diabetes who live in the Illawarra area of Australia. Griffiths & Moses (1992) surveyed people with diabetes aged less than 40 years. During 1989 40/196 (20%) respondents were admitted to hospital with an average LOS of 10.2 days for patients aged less than 19 years and eight days for those between 19 and 39 years.

5.2 DRG assignment problems for chronic disorders

The most important measure of casemix in the current funding context is the Diagnosis Related Groups (DRG) classification. As explained in Chapter 2, cases are assigned to DRGs largely on the basis of three attributes of the complete inpatient episode: the principal diagnosis, the most costly procedure, and the highest-ranking secondary diagnosis (a comorbidity or complication expected to increase length of stay by at least one day in 75% of cases). Other variables taken into account in some circumstances are age, gender, admission weight, and destination after discharge (home, transfer or death) (ACCC 1994:12).

Perhaps the most significant unresolved issue with respect to DRG performance is that of classification of acute inpatient episodes which are associated with chronic conditions. The onset of, and recovery from acute medical and surgical disorders is easily identified with common protocols for care, and relatively little variation in length of stay in most cases. However, acute care hospitals do not only treat people with acute illnesses and the assumptions of the AN-DRG methodology may be problematic for patient groups that are difficult to classify into discrete episodes of care which relate to a single setting.

An important problem with respect to the current rules and definitions is that they are difficult to apply with precision to all episodes of inpatient care. It has been reported that significant errors occur in selection of principal diagnosis by clinicians and in the coding (Magennis, Oakeshott, Rothwell, Smith & Truman 1994; Roberts et al. 1993; Connell et al. 1984; Reid 1988). Coding errors can significantly reduce reimbursement, and the quality of research based upon the data (Currie 1985; Doremus & Michenzi 1983; Donoghue 1992).

In response to the requirement to accurately describe resource consumption and patient characteristics, alternative classifications are being developed for patients identified as sub-acute (Magennis et al. 1994) and non-acute (Roberts et al. 1993). Several competing, or complimentary casemix classifications, have also been proposed or developed, such as the Severity of Illness Index (Horn, Sharkey & Bertram 1983; Hindle et al. 1990; McGuire 1991) and APACHE-L, (Wagner & Draper 1984) to enable a more accurate representation of the resources used to treat inpatients.

While these difficulties affect all case types, there are particular problems for chronic conditions; and especially for those with the complexity of diabetes. Studies have shown that there are substantial error rates in diagnostic coding of diabetes related admissions and ambiguity in how the diagnosis of diabetes can, or should, be applied (Connell 1e al. 1984; Leslie et al. 1992). The management of chronic disorders cannot be easily separated into discrete episodes of care nor can the pattern and quantity of resources be predetermined for individual cases with any degree of certainty. The management of chronic disorders requires life long surveillance by a range of healthcare professionals, across settings.

Of the three distinctive features of a casemix classification, two are difficult to apply to chronic disorders with any degree of accuracy. First, the quantity and nature of resources consumed by individual patients with the same chronic disorder can at best only be described in broad terms. Second, chronic disorders often involve multiple system dysfunction and individual responses represent a wide range of variance. As a result two people with the same disorder may have different requirements for care. This situation provides an incentive for hospitals to maximise the number of low cost patients within each DRG and minimise admission of high cost patients, many of whom are costly to treat because they also have a chronic disorder as a secondary diagnosis.

There are fundamental differences between acute and chronic disorders with regard to onset, duration and course of management. The resulting implications for healthcare providers are that it is unlikely that the current AN-DRG classifications capture the true episode of care for chronic conditions. Therefore, the resource implications of chronic disorders for funders and providers of healthcare is unclear.

5.3 DRG assignment issues and diabetes

Patterns of care for people with diabetes include ongoing inpatient, outpatient and community care, often with frequent readmissions for stabilisation, management of complications and ongoing assessment and change of treatment. While there are predictable commonalties in a group of people with diabetes, the clinical picture varies significantly between individuals according to their level of control and need of treatment for complications. This reality, which is at odds with the DRG logic, has previously been identified as a weakness in the methodology of the ICD-9-CM which was designed to group diseases not patients (Gonnella, Hornbrook & Louis 1984). Because of the diversity between patients, and the high incidence of diabetic complications, the potential for gaming (DRG creep) where diabetes is present was also noted. Episodes of care for diabetes could be coded to optimise reimbursement by assigning complication codes inappropriately.

Coding and recoding studies have been undertaken in Australia (Reid, 1991; Donoghue 1992), and overseas (Connell et al. 1994; Lloyd & Rissing 1985;

Williams 1985). While methodological differences make comparisons difficult, a general finding of these studies is that clinical and coding inconsistencies, and inaccuracies compromise data quality. The problems identified by researchers with respect to diabetes include incorrect principal diagnosis and inaccurate estimation of resource consumption, both of which are largely attributed to the complex nature of the disorder (Connell et al. 1984; Bransome 1986; Leslie et al. 1992) The incongruities manifest as inaccurate discharge data, lack of morbidity and mortality data, and an underestimate of the cost of care. The consequences of inaccurate data impacts upon healthcare facilities, researchers and health service planners.

While this study was not intended to assess the accuracy of coding, problems with the DRG classification and the ICD-9-CM guidelines are significant from the perspective of the hypotheses identified for this study.

5.3.1 Issues relating to the principal diagnosis

Audits of discharge summaries associated with the management of diabetes related complications have shown that there high error rates in coding the principal diagnosis, and also considerable variation in clinical decision making, and opinion about the cause of the admission. Some clinicians identify the primary diabetes as the principal diagnosis, while others identify the resulting complication as the cause for admission. To further compound the situation, coding errors occur as a result of ambiguous documentation on discharge summaries, as well as inaccurate selection by coders (Connell et al. 1984; Williams 1985; Leslie et al. 1992).

Connell et al (1984) undertook an analysis of discharge data in an attempt to explain variances for diabetes related admission between 39 counties in an American State. The aim of the study was to determine whether the differences were due to coding practices or errors. The extent to which ambiguities occur, and the effect they have on the measurement of admission rates and average length of stay was researched Connell et al. (1984). Of the 574 records that were reabstracted, 49% of admissions were solely for diabetes care, 31% involved treatment of one other condition and 20% entailed treatment of more than two conditions. Of the records originally coded to a principal diagnosis of diabetes, 23% were considered to be ambiguous because more than one justifiable principal diagnosis, or diabetes related complication which might be more appropriate as the principal diagnosis, was identified in the record. Ambiguity relating to the principal diagnosis also resulted in 11% of discharges originally coded with diabetes as the secondary diagnosis being reclassified.

In over 50% of discharges where diabetes could reasonably be identified as the principal diagnosis, one unequivocal reason for admission could not be identified (Connell et al. 1984). This is not an uncommon situation for patients with diabetes who often receive treatment for a number of conditions during hospitalisation as a result of the high incidence of diabetes related complications. Diabetes also has a high incidence among the elderly, who are a group of patients recognised to require treatment for multiple disorders.

The second reason for ambiguities with the principal diagnosis identified by these researchers, arose as a result of confusion among medical practitioners about the meaning of the term 'principal diagnosis', as opposed to the underlying or primary diagnosis. This loss of specificity when applying the definitions often arises when a patient is admitted for management of a diabetes related complication.

Overall, these researchers found that only 60% of principal diagnoses were coded correctly. Furthermore, 17% of discharges originally coded with diabetes as the principal diagnosis, were changed after reabstraction to diabetes as a secondary diagnosis. These errors occurred primarily because of incorrect sequencing of codes (Connell et al. 1984). The principal diagnosis was more likely to be correctly identified in those cases where diabetes was identified to be the reason for admission however, overall only 64% of admissions were coded accurately. While the average LOS did not appear to be affected by coding criteria, admission rates for individual DRGs were dramatically affected by the selection of the principal diagnosis.

The records where diabetes was listed as the secondary diagnosis were also compared. The researchers found that patients with diabetes related complications listed as a secondary diagnosis usually required complex care relative to those with a non-diabetes related secondary diagnosis (Connell et al. 1984).

They identified substantial error rates in the coding of episodes of care associated with diabetes, and considerable ambiguity in how the diagnosis should be coded. In diabetes it is not a straightforward coding decision, because many patients have multiple disorders which makes identification of a definitive principal diagnosis difficult. The potential for DRG creep to optimise hospital reimbursement for patients with diabetes was also recognised in their study.

As a result of these findings, Connell et al. (1984) concluded that the use of the principal diagnosis as the sole method for case finding was not reliable, and that ambiguities in diagnostic coding and clinical decision making limited the usefulness of the data for research purposes. They also recommended that strict criteria and standards be developed as a precursor to studies assessing the reliability or validity of discharge data. It was also noted that doctors reported scepticism of a classification system which is founded on an idea which has relatively little meaning (Connell et al. 1984).

5.3.2 Morbidity, mortality and estimates of resource consumption

The outcomes of care are attracting attention as funders and providers of health services seek objective data that can be used to measure, and compare, the effectiveness and efficiency of services. In Australia, diabetes has been selected as the focus of the New South Wales Department of Health outcomes project. Working parties of health professionals, consumers and policy analysists are developing consensus guidelines for education, screening and management of diabetic complications, and the management of diabetes in pregnancy (NSW Health Department 1996).

Munoz et al. (1989) undertook to estimate the cost differential associated with increasing morbidity and mortality in patients with diabetes. Data were compiled using the ICD-9-CM diagnosis code for patients with IDDM and NIDDM as either a principal or secondary diagnosis. Clinical variables such as use of blood and/or plasma products, admission to intensive care, and admission through the emergency department were also considered. The total number of ICD-9-CM codes, including procedure codes documented in each record, were adopted as a proxy for severity of illness.

Results indicated that the cost of treating patients who died during the admission was significantly higher, in this study (129.7%) than for survivors. The duration of hospitalisation prior to death was also found to significantly influence the total cost. While those patients who died within seven days of admission were 'profitable', the mean cost of patients declined as length of stay increased. While the mean DRG cost weight index per patient generally did not differ significantly regardless of length of stay, total hospital cost per patient, losses under DRGs, and outliers, increased as length of stay increased.

They noted that although those hospitals that were believed to be treating more severely ill, or expensive patients, received an additional subsidy to their DRG payment, all patients with diabetes incurred a greater cost to the hospital, and as a result they hypothesised that facilities are generally under-reimbursed for treating people with diabetes.

These authors went on to raise the question of 'budget neutrality' in this context. When associated with prospective payments, budget neutrality mandates that any increase in payments for a particular group of patients, must be balanced by decreased payments for other patients (Munoz et al. 1989). The suggestion that patient groups with high morbidity are unprofitable under DRGs, introduces ethical, as well as reimbursement issues, that until now may not have been considered by funders and providers of services.

In the hospital situation clinicians are increasingly required to account for resources. Their budget justifications often contain evidence of admission rate and bed occupancy which is generally obtained from discharge data. If this data is the sole justification used, research indicates that admissions associated with diabetes may be significantly underestimated. Leslie et al. (1992) found that audits of discharge summaries under-reported admissions where diabetes was both the principal and secondary diagnosis. Whether the patient had NIDDM or IDDM was usually not documented, or incorrectly recorded for medical and surgical patients. When the diagnosis of diabetes was made during the admission under review, only 48% of records contained that information.

The data, coded to ICD-9-CM, indicated that diabetes accounted for 2.8% of admissions. However, extrapolation from audit results indicated the true estimate to be 5.6% of admissions. The incidence of complications was also found to be under-reported in the majority of admissions by the fourth digit ICD-9-CM coding option. Sixty six percent of records audited indicated that patients required a change in their diabetes treatment during hospitalization, however such interventions were not reflected in the coding (Leslie et al. 1992). In the study by Leslie et al.(1992), discharge data based upon ICD-9-CM codes underestimated diabetes admissions by 100%, (2.8 reported vs 5.6% actual) and bed day occupancy by more than 200% (4.3 reported vs 13.7% actual).

The data reported by Leslie and co-workers (1992) accords with the findings of Williams (1985) who found an increased bed usage by people with diabetes compared to people without the disorder. That situation applied regardless of whether diabetes was the principal or secondary diagnosis. Failure to document the discretionary fourth and fifth digits to code for type of diabetes and presence of complications, was also common and again the official data significantly underestimated patient severity, and resource consumption. Williams (1985) concluded that, as a result of under reporting of diabetes related admissions and the extent of associated complications, the ICD-9-CM coding of hospital admissions fails to fulfil its potential as a demographic and epidemiological record of the resources that are used to treat a common and resource intensive condition. In the light of evidence, it is likely that hospitals are being under-reimbursed for the care that is provided (Munoz et al. 1989). The validity of the initial data that were used to determine the cost weights allocated to the diabetes DRGs, could also be questioned as a result of the findings.

Bransome (1986) believes that this situation should be of concern to those clinicians who provide diabetes care. The concern is that the general under reporting of the condition will result in an underestimation of the extent of the problem. As a result, funders may restrict ancillary services, such as patient education and dietary consultations, which are fundamental to successful diabetes care. The American Diabetes Association has taken up these issues with the Health Care Financing Administration (HCFA), the organisation administering the Medicare Prospective Payment System (PPS) in America (American Diabetes Association 1993).

5.3.3 Severity of illness

Gonnella et al. (1984) considers that one of the weaknesses of the design of DRGs is that they do not include a mechanism to account for severity of illness within a particular diagnosis. Given that DRG reimbursement is based upon the average cost of treating patients in a particular category, the incentive for hospitals to admit only less severe cases in each classification cannot be ignored (Newhouse 1983). The development of scales to measure severity within DRGs, by taking into account associated mortality and morbidity resulting from the disease, is an attempt to reduce the financial burden associated with the management of high risk groups of patients (Horn et al. 1983; Gonnella et al. 1984; McGuire 1991; Hindle 1990).

A severity of illness index developed by Horn et al. (1983) classifies patients into one of four levels ranging from asymptomatic to catastrophic based upon seven variables and according to the level of care required by the patient. While recognising the ability of severity measures to improve the equity of the prospective payment system, the possibility of significantly increasing the cost to funding bodies by shifting an episode of care to a DRG with a higher cost weight, must also be considered. (Simborg 1981; Mullin 1985; McGuire, 1991)

Hindle et al. (1990) described a weighting procedure in which a complexity score could be computed as a measure of the secondary diagnosis. This relatively simple, yet logical approach to estimating resource consumption, and classifying patient groups would overcome some of the concerns about the accuracy and reliability of DRG data.

Gonnella et al. (1984) applied disease staging to diabetes related admissions to demonstrate the effect of discriminating between patients within the same DRG. Staging in this study, did not depend upon patterns of resource utilization or on expected responses to therapy. Rather the staging used a conceptual model based upon the disease process, and required expert clinicians to develop medical criteria that were then applied to individual records. Disorders were divided into categories of increasing severity. Stage 1 were conditions with no complications or problems of minimal severity. Stage 2 included disorders limited to an organ system but with an increased risk of complications. Stage 3 included conditions with multiple site involvement and a poor prognosis, and episodes of care where the patient died were assigned to Stage 4.

The model was applied to discharge data from 373 hospitals providing data for 392,456 individual patients. Results demonstrated that patients who were older, were admitted through the emergency department, and who had surgical procedures, were more likely to have higher severity ratings. The length of stay also correlated with the disease stage, with those patients admitted to a hospital affiliated with a medical school staying on average 4.5 days longer.

The finding from that study with particular significance for the study described in this thesis, is that results demonstrated that episodes of care for diabetes could be grouped according to the presence of factors considered likely to increase the need for resources. Patient related factors such as age, presence of unrelated comorbities and family support are examples. The resulting groups demonstrated within group homogeneity and between group heterogeneity, and were therefore considered to be a viable framework to apply to DRG based reimbursement.

5.4 Summary

Diabetes is a major public health problem with associated social and financial costs to individuals, and the health system. However, as the result of ambiguities, discrepancies and inaccuracies in clinical documentation, DRG design, and coding, the true cost of resources used to treat inpatients with the disorder is unlikely to be readily obtained from hospital data.

The ICD-9-CM classification has been implicated as a weakness in the classification of disorders where patient characteristics are difficult to precisely predict and define. Procedures such as disease staging have been applied by researchers to diabetes related episodes of care, and have been found to more accurately reflect resource utilization.

While DRGs may be suitable to group uncomplicated episodes of care that have a predictable course of treatment, the ability of the classification to accurately account for resources used to treat chronic conditions appears questionable.

CHAPTER 6

STUDY METHODOLOGY

STATEMENT OF THE PROBLEM

AIM OF THE STUDY

DESIGN STRATEGY

SAMPLE SELECTION

DATA CAPTURE

METHODS OF DATA ANALYSIS

Chapter 6 Study methodology

This chapter describes the method of study. In outline, a sample of computerised discharge records was obtained in which there was at least one diabetes diagnosis. A sub-sample was selected and the complete medical records reviewed for indications of coding errors and resource use. Additional discharge records were found where, although the patient was known to have diabetes, no diagnosis had been entered to the discharge record.

The selected records were then described in various ways. Finally, analyses were conducted to assess the extent to which the DRG classification was able to describe the diabetes cases in clinically sensible and iso-resource terms.

6.1 Statement of the problem

The Diagnosis Related Groups (DRG) classification was developed to categorise inpatient episodes in acute care hospitals in the United States in the early 1970s. It happened to be the case that most of their patients were short-stay admissions with acute medical and surgical conditions, and the DRG logic was developed for the specific purpose of categorising this casemix.

It has been assumed until recently that Australian hospitals (and those in some other countries) have the same kinds of casemix as the hospitals in the United States which were the determinants of the DRG classification logic. In fact, there are some important differences including (but not restricted to) patients with chronic conditions.

Assignment to an AN-DRG is based primarily upon the principal diagnosis or the main procedure. While these attributes may be efficient discriminators for short-stay episodes of acute care, they are unlikely to be similarly efficient for other types of patients.

A simple example of the potential problems is where the patient is admitted for treatment of an acute condition (such as a fracture) and happens to require ongoing care for significant consequences of diabetes. The standard DRG logic may be sufficient to categorise the acute condition, but there is reason to hypothesise that it would tend to underestimate the costs of coterminous treatment of the chronic condition.

The DRG logic allows secondary conditions (comorbidities and complications, or CCs) to be taken into account, but not in all circumstances. For example, cases admitted for seizure are split according to presence or absence of CCs (DRGs 45 to 47), but those admitted for headache (DRG 48) or carpal tunnel release (DRG 30) are not. Another potential problem is that of failing to discriminate between the CCs. For example, it might be hypothesised that a case where the CC is diabetes would tend to be more costly to treat than cases in the same DRG where the CC is a minor post-operative complication which requires to be monitored but not actively treated.

Another is that, even within a single condition defined to be a CC, there could be significant variation. Indeed, there is evidence that (unlike most acute disorders) chronic disorders cannot be easily separated into discrete episodes of care. Moreover, the pattern and quantity of resources cannot be predetermined for individual cases with any equivalent degree of certainty. This is problematic for people with diabetes. While there will be commonalities between people with the disorder, the high level of clinical diversity means that patterns of care can, at best, only be described in broad terms.

Previous research has addressed the effects of coding methods (and particularly of coding errors) on DRG assignment in Australia (Roberts et al. 1985; Reid, 1991; Donoghue, 1992). However, no specific attention has been paid to the implications for cases with diabetes diagnoses. Nor have the funding implications been considered in detail, either for diabetes or for any other common chronic disorders. In summary, the adequacy of DRGs with respect to categorisation of diabetes cases, including the variable effects of such aspects of data abstraction as selection of principal and significant secondary diagnoses, has not been adequately investigated.

6.2 *Aims of the study*

The aims of this study were to examine how the AN-DRG classification categorises patients with diabetes, and to assess the extent to which the resulting assignments are clinically coherent and resource-use homogenous. Where weaknesses are observed, recommendations will be developed for improvement in future DRG versions.

Formal statement of hypotheses
Primary hypothesis : That resource consumption by inpatients with diabetes is effectively explained by the AN-DRG classification. Sub-hypotheses : 1. That the DRG classification rules result in patients with diabetes being appropriately assigned to clinically meaningful and resource-homogeneous classes. 2. That the presence of diabetes as a significant comorbidity or complication is precisely recorded in the discharge database. 3. That the presence of diabetes as the principal diagnosis is precisely recorded in the discharge database.

The main subsidiary objective was to assess the extent to which the presence of diabetes was precisely recorded in the discharge record. This would include issues of abstraction and coding.

6.3 *Design strategy*

In order to adequately explore the research questions listed above, it would be necessary to obtain a sample of discharge records from Australian hospitals which met the following minimum criteria:

- cases could be assigned to DRGs

- the presence of diabetes had been recorded with known (or auditable) accuracy

- length of stay (or some other) indicator of resource use was available for every record.

If these criteria were met, it would be possible to test the efficiency of DRG assignment rules in terms of explanation of variations in length of stay. However, this would not be sufficient by itself. In particular, there would need to be the capability to make the following kinds of checks:

- whether diabetes was in fact present in the records (that is, whether there had been errors of over-recording)

- whether diabetes was treated during the episode but not recorded.

Several research designs were considered. For example, it would have been possible to undertake a prospective study. This would have some advantages, including that of allowing the level of misrecording to be controlled. It would also have some disadvantage, such as not allowing the current level of precision to be measured.

In the event, practical considerations meant that prospective analysis was not feasible. It was therefore decided that a retrospective survey of data for the most recent complete financial year would form the core of the study. The analyses would be largely descriptive; that is, the aim would be "... to describe the nature of existing conditions, identify standards against which existing conditions can be compared, or to determine relationships that exist between specific events". (Cohen & Manion 1984)

Opportunities for modelling and simulation would, however, be taken where possible. In particular, there would be exploration of optional methods of assignment of discharges to classes.

6.4 Sample selection

A sample of discharges was required, which could be analysed in terms of DRG assignments (and optional classifications). The obvious source was the computerised Inpatient Statistics Collection maintained by all hospitals in New South Wales (and in almost identical forms in the other States and Territories).

It was also necessary to explore the accuracy of discharge abstraction. The most efficient approach was considered to involve the selection of a sub-sample of the computerised discharge records, which might then be reviewed by direct analysis of patient medical record files.

Finally, a sample of records was required to be reviewed for which there was no indication of a diabetes diagnosis in the computerised discharge file. Several options were available, such as random selection of medical record files which might then be searched for evidence of diabetes. In the event, a more efficient method of locating diabetes was chosen, involving use of a file of clients of a community-based health service directed exclusively at those known to have diabetes.

For practical reasons, it was decided that the study should be restricted to clients of the Illawarra Area Health Service (IAHS) in New South Wales. In particular, there would be insufficient resources to undertake medical record abstraction at distant sites.

At this stage, it is important to understand the basic elements of the health care record system in the IAHS. A key feature is that each inpatient is assigned a unique identifier termed the Medical Record Number (or MRN) on the first occasion of contact with any of the public hospitals in the area. Once allocated, it is used on all subsequent occasions of care provision at any facility. It is therefore possible to track a patient across the Area and over time, and to develop profiles of service utilisation by individuals.

At the time of the study, there were four public hospitals with significant numbers of acute admitted patient care episodes in the IAHS: Coledale

Hospital, Bulli District Hospital, Illawarra Regional Hospital, and Shellharbour District Hospital.

All are located within 25 minutes driving time from the central business district of Wollongong, and provide care for the population of around 300,000. The Illawarra Regional Hospital (IRH) is a recent amalgamation of the Wollongong and Port Kembla Hospitals, and is distributed across two campuses about 10 km apart. However, discharge data are maintained as if there were a single hospital, and therefore no discrimination between campuses is feasible or desirable in the context of this thesis.

6.5 Data capture

In overview, the main sample comprised all discharges from the four main hospitals during the financial year 1993-94 for which there was one or more diagnosis indicating diabetes. There were 2185 admissions in this sample. For reasons described later, 61 cases from Coledale Hospital and 30 cases involved in a pilot study were removed at a later stage, thus leaving 2094 for subsequent analysis. This set of records is termed the diabetes identified sample below.

As noted above, some additional records were selected where there was evidence from another source (the Diabetes Education and Information Unit) that the patient had diabetes. For various reasons, the selection was largely purposive and comprised only 22 cases admitted to the Illawarra Regional Hospital. This set of records is termed the diabetes not identified sample below.

Finally, the medical record audit was conducted on a subset of 386 cases. This is termed the audit sub-sample below. Each group is described in more detail below.

6.5.1 The diabetes identified sample

This sample was abstracted and subsequently sub-categorised for the purpose of analysis. The main steps were as follows.

1. The computer records were retrieved for all inpatients for whom diabetes was recorded in the IAHS discharge database in the period from 1 July 1993 to 30 June 1994.

2. Some records were excluded from the study, as described below.

3. Records were then assigned to groups to take account of the main features of DRG assignment logic. Four groups were initially identified: diabetes selected as principal and assignment to a DRG defined by diabetes, diabetes as principal but assignment to a DRG not defined by diabetes, diabetes not selected as principal and where the DRG was not

split on CCs, and finally where a diabetes diagnosis was present and assignment was to a DRG defined by CC.

4. The fourth group (assignment to a DRG split by CC) was subsequently subdivided into those discharges where diabetes was the only significant secondary diagnosis (and therefore represented the sole reason for assignment to the with-CC class) and the remainder where there were other secondary diagnoses defined to be CCs.

As noted above, some records were excluded from the study. First, cases treated at the Coledale Hospital were excluded because of concerns as to their status as acute. This hospital actually provides care almost exclusively for elderly and long-stay cases (variously termed non-acute, nursing home type, convalescent, or respite). As is demonstrated in the results, these patients are significantly different in length of stay to those admitted to the other hospitals in the IAHS for acute care. During the study period, a total of 61 patients with diabetes were discharged or transferred from the Coledale hospital.

Second, records of women with Gestational Diabetes Mellitus (GDM) were excluded from scope. The ICD-9-CM code for GDM was not included in the computer search to identify the study population. This was primarily because it is known that, for the majority of women, GDM is a transitory state of glucose intolerance which resolves after the birth of the baby.

Finally, 30 records from the Bulli District Hospital and IRH were excluded, because they had previously been selected for the purpose of testing data capture methods.

The distribution of the sampled records across DRGs and between the groups is presented in Chapter 7, but the assignment rules are summarised in Table 6-1. Note that selection of a diabetes diagnosis as the principal diagnosis does not always result in assignment to the diabetes DRGs (529 and 530). In fact, 13% of these cases were assigned to other DRGs (most of which involved procedures, and the remainder involved diabetes-related manifestations).

Note also that, even though diabetes is generally a significant comorbidity in practice, it is often ignored by DRG logic. In fact, the large majority of patients with diabetes were assigned to group 3 (classes where there is no CC split).

Table 6-1 : initial assignment of sample cases to groups according to DRG logic

Group	Description	Attributes		
		DRG assignment	Principal diagnosis	Significant secondary diagnoses
Group 1	Principal diagnosis of diabetes, assigned to one of two AN-DRGs for diabetes	DRG 529 or DRG 530	Diabetes	Not relevant
Group 2	Principal diagnosis of diabetes, assigned other AN-DRG	Various	Diabetes	Not relevant
Group 3	Secondary diagnosis of diabetes, assigned to AN-DRG cluster not split by CCs	Various, not split by CC	Not diabetes	Diabetes
Group 4	Secondary diagnosis of diabetes, assigned to AN-DRG cluster split on CCs	Various, split by CC	Not diabetes	Diabetes

The subsequent split of group 4 into two parts, as shown in Table 6-2, was made after some initial analyses, which showed that diabetes was rarely the only significant secondary diagnosis. This was not surprising, given the nature of the disease.

Table 6-2 : new groups as created by split of original group 4 into two parts

Group	Description	Attributes		
		DRG assignment	Principal diagnosis	Significant secondary diagnoses
Group 4	Secondary diagnosis of diabetes, assigned to AN-DRG cluster split on CCs	Various, split by CC	Not diabetes	Diabetes only as CC
Group 5	Secondary diagnosis of diabetes, assigned to AN-DRG cluster split on CCs	Various, split by CC	Not diabetes	At least one other non-diabetes diagnosis as CC

However, it was not anticipated that the effects would be so great: in the sample, hardly any cases were in the new group 4, where diabetes was the only comorbidity or complication.

6.5.2 Diabetes not identified sample

It was necessary to check whether patients with diabetes were being fully abstracted in the discharge database. Rather than conduct a random search of records having no diabetes diagnosis, another data source was used: the records of the Diabetes Education and Information Unit (DEIU).

In principle, the best approach would have been to scan all patient records in the DEIU database, identify patients who had acute hospital admissions during the study period, note the identification numbers (MRNs), and then undertake a complete interrogation of the hospital discharge database. The records thus located would then be randomly sampled for the purpose of audit of the medical records.

However, this was not feasible. The DEIU database is not computerised. Moreover, not all admissions are recorded.

It was therefore decided that a purposive sample would be taken, involving only those cases in the DEIU database which had been admitted to the IRH, Wollongong Campus.

The selection was restricted to this hospital for two reasons. First, the DEIU records are always updated to indicate an admission to this site, but this is not the case for other hospitals. It is a consequence of current clinical practice: diabetes educators conduct ward rounds every day at the IRH Wollongong, whereas they visit the other hospitals less frequently. Second, previous audits have shown that the Wollongong records could be considered to be close to 100% complete.

At the end of this process, all admissions to the IRH Wollongong campus between 1 July 1994 and 31 December 1994 had been identified, which related to patients of the DEIU not previously identified through the search on diabetes codes. All their medical record files were able to be retrieved, and it was found that all had been coded to ICD-9-CM for allocation to AN-DRG version 1.

6.5.3 The audit sub-sample

The process of sample selection is summarised in Figure 6-1. It shows that the audit sub-sample was selected from the diabetes identified sample, after the exclusions had been made as described above. The sub-sample was drawn randomly by two strata (hospital and group). The group stratum comprised the five groups described above, as defined according to principal diagnosis, CC, and DRG assignment.

In detail, the records were sorted into ascending order based on the MRN for each of the five groups separately and then arranged by hospital. The fifth record from each hospital was selected to provide a systematic sample. Fourteen of the selected records could not be located or had reports missing, and this gave a total sub-sample of 386 records available for audit.

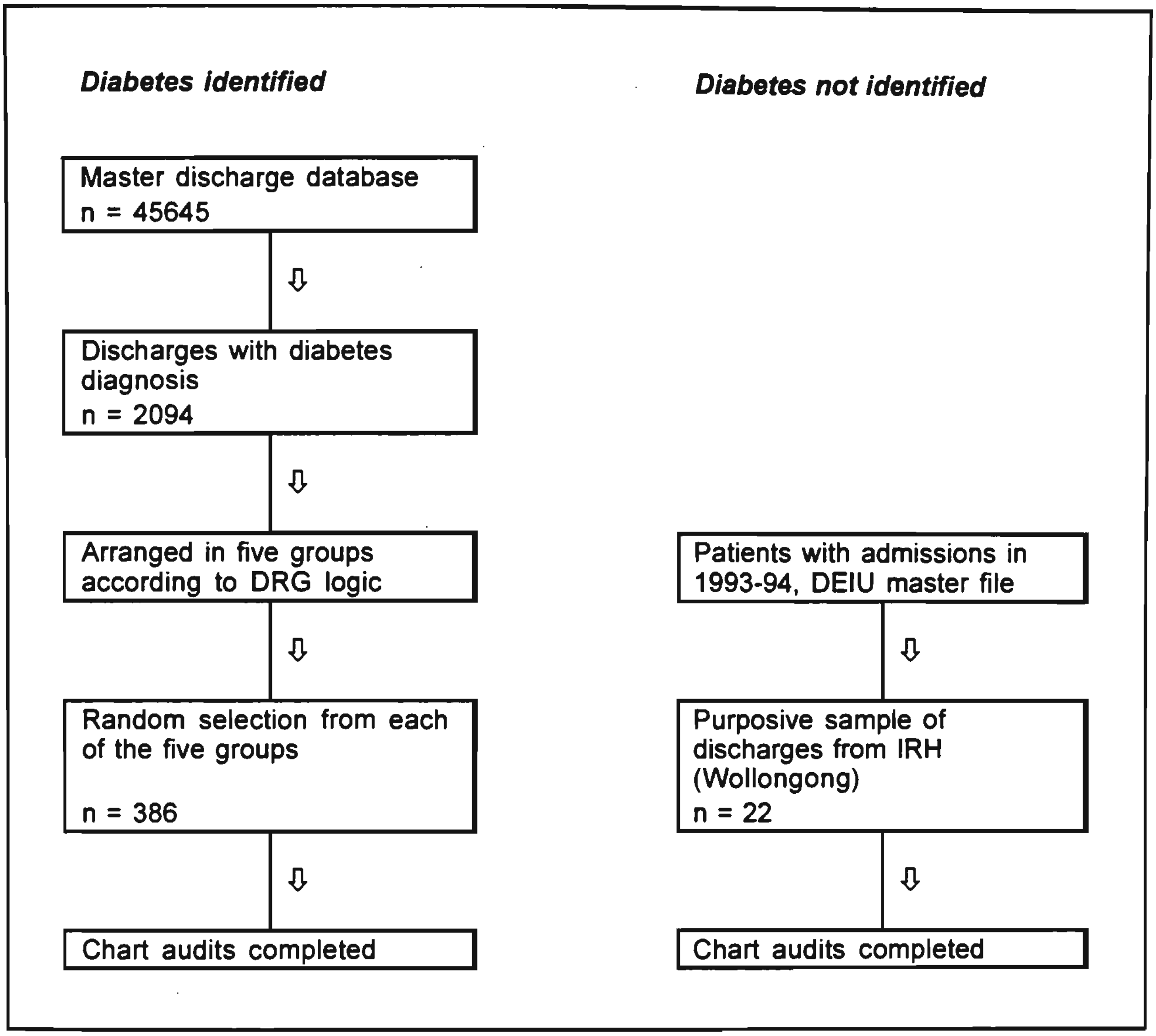
Data were collected using the 'Coding of Diabetes - Chart Audit' form designed by the researcher, which is shown in Appendix 1. Local development of the form was necessary because an extensive literature review failed to identify an existing audit form that was capable of extracting the data required. While computer analysis of LOS and diagnosis data used established statistical methods, clinical observations from the admissions being reviewed were required in order to test all of the hypotheses.

The chart audits were performed by a trained and experienced coder by complete re-abstraction. Expert medical advice was obtained from a physician who specialises in diabetes, for the purpose of independent verification of the code changes in four records.

Two main purposes were served by this process. First, records selected for the study were audited and reabstracted to note whether diabetes was the principal diagnosis or a secondary diagnosis. Second, the opportunity was taken to estimate the resources used to manage diabetes during the episode.

The distribution of diabetes cases among DRGs was examined to determine differences in length of stay between the diabetes cases and other cases in the DRGs, and whether patterns of resource consumption differed between the diabetes cases and the DRG as a whole. For those records where the opinion of the coder taking part in this study differed from the recorded codes, these discrepancies were noted on the audit form.

Figure 6-1 : flow chart for completion of chart audit



A pilot study was undertaken, mainly for the purpose of testing the audit process. Before the start of the pilot study, the draft audit form was reviewed by trained medical record coders and by experts in the areas of casemix and hospital information systems.

Thirty medical records in which diabetes was listed as a diagnosis were identified on the IAHS discharge data base, retrieved, and audited by the researcher and a medical record coder to test the adequacy of the audit form.

The Medical Record Departments of the Bulli District Hospital and the IRH were used for this stage of the research.

The audit form was found to be effective for the collection of the data and was used unchanged to collect data for both groups in the main study.

6.6 Methods of data analysis

Standard methods of analysis were applied to the interpretation of descriptive statistics generated by the study. Where analysis was undertaken of ratio scale data, results are expressed as means with one standard deviation in parentheses, or as percentages (unless otherwise specified). The Kruskal-Wallis Test, a non-parametric one-way ANOVA, was used to compare the means of the various populations (such as the mean LOS between hospitals). Results of the Kruskal-Wallis Test are presented as a Chi-Square Approximation.

The Student's 't' Test was used as a parametric test of differences of means of groups (such as the age by hospital for each of the five groups). Spearman's Rank Correlation Coefficient was used to examine the strength of the association between two variables, for example, the relationship between age and LOS. The Kolmogorov-Smirnov Test was used to test if a sample was representative of the population from which it came. Pairwise analysis was used to identify differences between components of larger groups (for example, differences in LOS for patients from each hospital within the same group).

Results are considered significant at $p<0.05$. The SAS statistical package was used for analysis of data (SAS Institute Inc: Cary NC 1990).

Measurement of classification homogeneity

There are many ways of classifying patient care episodes. The structure which appears optimal for one person may be less attractive to others, and no single classification will be optimal for all intended uses. One key step is therefore the application of a statistical measure of the extent to which options are able to attain within-class homogeneity (whether defined by cost, utility, or whatever).

The most commonly used statistic is R^2, the coefficient of multiple determination which is computed as follows:

$$R^2 \quad = \quad BSS / TSS \quad \text{and} \quad BSS \quad = \quad TSS - WSS$$

where

BSS : between-class sum of squares
TSS : total sum of squares
WSS : within-class sum of squares

$$TSS : \quad \sum_J \sum_i (y_{iJ} - M)^2$$

$$WSS : \quad \sum_J \sum_i (y_{iJ} - M_J)^2$$

BSS : $\sum_{J} n_J(M_J - M)^2$

where

y_{iJ} : score for observation i in group j

M_J : mean score for group j

M : grand mean across all n observations.

(Developed by Pearson, cited in Lagaida & Hindle 1996:106)

It is simply a measure of the proportion (or percentage) of variation among the cases which is between (rather than within) the classes. If a classification is effective, R^2 will be close to one because most of the variation will be between cases in different classes (and cases within the same class will have similar values). Conversely, R^2 will be close to zero if the classes are internally heterogeneous.

A derivation of R^2 has been widely used in Australia, the Reduction in Variance (RIV) statistic, which is computed as follows:

$$RIV = 100^* R^2$$

There is no difference of any significance. As might be expected, a high RIV indicates that the assignment of episodes of care into classes has resulted in identification of distinct, and homogeneous sub-groups of the population.

In addition to having a measure of classification performance, it is preferable to have an efficient process of generation of potentially useful solutions (which can then be compared in terms of R^2 and in other ways). The most widely known searching method is that developed by Morgan and Sonquist (1963) in the early 1960s, which is generally termed automatic interaction detection (AID). It was subsequently extended and established as a mainframe application, and more recently it has become available as a microcomputer application.

The primary aim was to develop an approach which was better able to take account of interactions between the predictor variables. While techniques existed which identified the interactions, there was no established method for selecting the combinations of variables to be tested. The core idea of the AID approach was sequential splitting of the starting group and resultant sub-groups by testing the performance of all remaining variables. Each potentially useful split was tested in terms of the resulting reduction of within-group sums of squares, and the best predictor evaluated against a measure of significance. Where the split met the test, it was implemented, and the subgroup with the largest sum of squares considered as the next candidate for splitting.

The result of this process is a classification which takes the form of a tree. The classes are deemed to be terminal nodes when no further split can be made which results in a significant increase in variance explained. The measure of variance explained is R^2 as described above. It is typically associated with a measure of significance of the difference between the means of the starting group and the proposed subgroups. Where the predictor variables are ordinal, the recommended statistic is the F value. Where they are nominal, it is usually the case that χ^2 is employed.

The merits of this approach relative to the more widely used methods have been discussed in the literature. For example, several authors including Doyle and Fenwick (1984) have pointed out that there is a tendency to over-fit the data, especially if an automatic computer algorithm is used. Other authors, including Malitz and Godbout (1992), point out that the risk of overfitting can be reduced in several ways including random partitioning of the source data and the testing of robustness of the solution by comparison of results on the subsamples. They also note, quite correctly, that the problem of overfitting (and the more general issue of confusion of cause and effect in multivariate data sets with high levels of interaction) are not unique to any of the available analytical approaches. The requirement is that scientific methods are consistently applied, including those relating to a priori establishment of hypotheses based on a detailed understanding of the system to be modelled.

In this study, the aim is simply to measure the performance of the DRG classification with respect to patients with diabetes, and explore possibilities for improvement. The DRG classification assumes that cases that are clinically similar, as determined by the predictor variables, will be assigned to iso-resource groups using LOS as the dependent variable. An iso-resource group is one in which all cases cost approximately the same to treat.

Data were analysed to determine whether the predictor variables identified by the DRG logic adequately explain variations in costs using LOS as the dependent variable. The methodology employed to establish the reliability of the predictor variables had previously been used in studies designed to identify a standardisation strategy for AN-DRGs (Reid et al. 1991; Lagaida & Hindle 1992; Roberts et al. 1993; Hindle 1995).

Data were analysed using the PC-Group software, an interactive statistical package that enables classifications to be developed by grouping data according to identified independent variables (Austin Data Management Associates 1992). As previously described, Automatic Interaction Detection (AID) algorithms are applied to progressively partition a dataset into a hierarchy of subgroups.

Finally, ethics approval for this study was obtained from University of Wollongong and Illawarra Area Health Service Human Research Ethics Committee. The privacy of individuals was protected because no person was identified by name on the discharge data base or the chart audit forms. All data was identified by MRN.

CHAPTER 7

ANALYTICAL RESULTS

FEATURES OF THE SAMPLE "DIABETES IDENTIFIED"

FEATURES OF THE AUDIT SUB-SAMPLE

CLASSIFICATION PERFORMANCE IN TERMS OF LOS HOMOGENEITY

ANALYSIS OF THE SAMPLE DIABETES NOT IDENTIFIED

SUMMARY OF ANALYSES

Chapter 7 Analytical results

This chapter presents four main types of analyses. Section 7.1 describes features of the sample of discharges which had diabetes diagnoses. Section 7.2 describes the sub-sample of records with diabetes which was selected for the purpose of medical record audit.

Section 3 describes the extent to which cases with diabetes diagnoses are assigned to resource-homogeneous groups by the DRG logic. Finally, a sample of records is described where the discharge database did not contain any diabetes diagnoses, but where it was known from other sources that diabetes was present.

7.1 Features of the sample "diabetes identified"

For the study period from 1 July 1993 to 30 June 1994, there were 45645 discharges from hospitals in the area, distributed as follows between the four sites providing acute admitted patient care:

Coledale Hospital	471
Bulli District Hospital	4524
The Illawarra Regional Hospital (IRH)	29287
Shellharbour District Hospital	11363

As noted previously, the sample was restricted to records from the Shellharbour, Bulli, and Illawarra Regional hospitals. Coledale Hospital, a 38 bed hospital specialising in geriatric and rehabilitation, was excluded from the sample because the admissions are known to be different by policy. In particular, this hospital is used for the care of long-stay and non-acute cases, as evidenced by the significantly longer lengths of stay.

In the following analyses, unless otherwise stated, the diagnosis and procedures codes are from the International Classification of Disease 9th Edition, Clinical Modifications (ICD-9-CM) and involve coding standards which applied in financial year 1993-94. The DRG data are for the Australian National Diagnosis Related Groups (AN-DRGs) classification, version 1.

The structure of the diabetes identified sample is summarised in Table 7-1. It shows that about 5% of discharges had one or more diabetes diagnosis. After the cases from the pilot study (n=30) and Coledale Hospital (n=61) were removed, the diabetes identified sample was reduced to 2094 discharges, or approximately 4.6% of the total discharges from the four hospitals.

Table 7-1 : descriptions and numbers of cases, the diabetes identified sample

			Cases
All discharges			45645
Discharges with no diabetes diagnosis			43460
Discharges with diabetes diagnosis			2185
Excluded discharges			91
	Coledale		61
	Pilot test		30
Discharges included in sample			2094
	Group 1	Principal diagnosis of diabetes, assigned to one of two AN-DRGs for diabetes	149
	Group 2	Principal diagnosis of diabetes, assigned other AN-DRG	24
	Group 3	Secondary diagnosis of diabetes, assigned to AN-DRG cluster not split by CCs	1448
	Group 4	Secondary diagnosis of diabetes, assigned to AN-DRG cluster split on CCs	473

Table 7-1 also shows the way in which the sample was partitioned into four groups to reflect the main features of AN-DRG logic. Episodes of care where diabetes was the principal diagnosis were assigned to Groups 1 or 2 based upon the ICD-9-CM code.

The principal diagnosis codes for all episodes in Group 1, direct DRG assignment to one of the two diabetes DRGs; 529 and 530. The principal diagnosis codes for majority of episodes assigned to Group 2 were for procedures or for diabetes related manifestations. As a result, these episodes were allocated to a DRG in an MDC other than MDC 10.

Diagnosis codes that result in the allocation of diabetes-related episodes to a non-diabetes DRG include 2504 (renal manifestations), 2505 (ophthalmological manifestations), 2506 (neurological manifestations), and 2507 (peripheral vascular circulatory disorders). For example, selection as principal diagnosis of the ICD-9-CM code 2504 (renal manifestations) results in the episode of care being assigned to a DRG in MDC 11 (diseases and disorders of the kidney and urinary tract).

Episodes of care assigned to Group 4, were analysed by DRG grouper software to determine whether the diabetes diagnosis had influenced allocation to the DRG. The DRG grouper is a software package that allocates episodes of care to an AN-DRG primarily according to the ICD-9-CM codes that have been allocated to the principal diagnosis and procedure and secondary diagnosis. (Reid et al. 1991; Hindle, 1992)

Only 10 of the 473 episodes were reallocated after all diabetes codes were removed from the data indicating that diabetes as a secondary diagnosis has little influence upon DRG assignment. In each case, removing the diabetes code resulted in the episode of care being moved from a DRG with CCs and reallocated to a DRG without CCs. The presence of diabetes as a secondary diagnosis influenced DRG assignment for the classes listed in Table 7-2.

Table 7-2 : DRGs where deletion of diabetes diagnosis affected DRG assignment

Initial DRG assignment		Cases
DRG 035	TIA and precerebral occlusions with CCs	1
DRG 045	Seizure age > 9 with CCs	3
DRG 257	Hypertension with CCs	1
DRG 268	Non-major arrhythmia and conduction disorders with CCs	1
DRG 332	Other digestive system diagnoses age > 9 with CCs	2
DRG 329	Oesophagitis, gastro-enteritis with CCs	1
DRG 433	Bone disease and specific arthropathies with CCs	1

Following this reassignment of AN-DRGs, records from the original Group 4, DRGs with CCs, were divided into two groups for further analysis. They are shown as Groups 4 and 5 in Table 7-3, which lists all five groups from which the audit subsample was selected.

Note that, of the 2094 records where diabetes was documented, it was selected as the principal diagnosis in only 173 (8%) of records. Although diabetes related complications result in high morbidity and mortality, 1537 (76.4%) of cases where diabetes was a secondary diagnosis, were assigned to a DRG without CCs, and in only ten cases was diabetes considered to be a significant CC.

Table 7-3 : groups in diabetes identified sample from which audit sample was selected

Group		Cases
Group 1	Principal diagnosis of diabetes, assigned to one of two AN-DRGs for diabetes	149
Group 2	Principal diagnosis of diabetes, assigned other AN-DRG	24
Group 3	Secondary diagnosis of diabetes, assigned to AN-DRG cluster not split by CCs	1448
Group 4	Secondary diagnosis of diabetes, assigned to AN-DRG cluster split on CCs, diabetes defined to be a CC, no other CCs present	10
Group 5	Secondary diagnosis of diabetes, assigned to DRG with CC, diabetes defined to be a CC, other CCs present	463
All		2094

On the basis of that assignment, it could be assumed that diabetes is a disorder of little consequence. This is at odds with the estimated annual cost of $272 million for the inpatient management of diabetes in Australia (McCarty et al. 1996). Part of the reason for this discrepancy could be attributed to flaws in data collection, recording, and reporting.

7.1.1 Analysis of age and length of stay patterns in the sample

Table 7-4 shows the pattern of lengths of stay in the diabetes identified sample, according to DRG logic group and hospital. A significant difference between hospitals was found in Group 3 (χ^2=83.261, df=3, p=0.0001). As the results show, patients at Coledale Hospital, with a mean LOS of 22.45 (+18.6) days, stayed significantly longer than patients at the other hospitals. As discussed previously, this is was not an unexpected finding given the patient profile of the Coledale Hospital and is the reason the data was excluded from the sample selection.

The DRG classification uses LOS as a predictor of resources consumed during hospitalisation. Episodes of care where the LOS is significantly longer than the average for that DRG are identified as outliers and funded separately. This 'safety net' has been set in place to ensure that those hospitals that provide care for 'sicker' patients are adequately compensated for the cost of care. The incidence of outliers in each hospital is monitored to ensure that the system is not used inappropriately to optimise funding.

Table 7-4 : mean length of stay (in days) by hospital and DRG logic group

Hospital	DRG logic group				
	1	2	3	4	5
Bulli	7.8 (±10.3)	9.5 (±7.7)	8.4 (±7.5)	-	8.2 (±6.2)
Coledale	70 (±0)	-	22.4 (±18.6)	-	34 (±0)
IRH	6.4 (+4.9)	8.9 (±12.0)	7.6 (±8.4)	7.3 (±5.1)	8.6 (±7.2)
Shellharbour	7.6 (±5.3)	4.5 (±7.0)	6.2 (±8.4)	5.4 (±2.5)	8.7 (±9.0)
	$p = 0.6559$	$p = 0.3986$	$p = 0.0001$	$p = 0.6434$	$p = 0.3389$

For the purpose of this study, differences in LOS are not considered to be significant unless the additional stay results in the episode of care being classified as an outlier, and reimbursed accordingly by DRG-based funding. Therefore, from the perspective of DRG-based funding, the differences in LOS between Bulli, IRH and Shellharbour hospitals are not significant.

It is normal practice (in the IAHS and elsewhere) to make additional payments for cases classified as high outliers, but it is less common for there to be reductions in payments for unusually short stays. This practice acts as an incentive to encourage hospitals to implement efficiency measures designed to minimise the period of hospitalisation. It follows that, under the typical DRG-based funding model, small variations in LOS are more significant for the hospital than for estimating reimbursement levels.

The mean age of patients admitted to each hospital for the five groups is shown in Table 7-5. Only one patient from Coledale Hospital was assigned to each of Groups 1 and 5. A significant difference was found for Group 3 (χ^2=44.242, df=3, p= 0.0001) and Group 5 (χ^2=13.872, df=3, p= 0.0031).

Patients in Group 3 admitted to the IRH were significantly younger than patients at Bulli Hospital (χ^2=23.953, df=1, p=0.0001) and patients at Coledale Hospital (χ^2=24.426, df=1, p=0.0001).. Patients admitted to Shellharbour Hospital were also younger than patients admitted to both Bulli (χ^2=14.130, df=1, p=0.0002) and Coledale Hospitals (χ^2=18.039, df=1, p=0.0001). When the age of patients admitted to Shellharbour Hospital and the IRH were compared, no significant difference was found.

Patients in Group 5 admitted to Bulli Hospital were significantly older than those at Shellharbour Hospital (χ^2=7.7101, df=1, p=0.0055) and the IRH (χ^2=11.122, df=1, p=0.0009). Once again no significant difference was found when the age of patients admitted to the IRH and Shellharbour Hospital were compared.

Table 7-5 : mean age (in years) by hospital and DRG logic group, diabetes identified

Hospital	Group 1	2	3	4	5
Bulli	60.3 (±14.8)	68 (±19.7)	71.0 (±7.5)	-	73.9 (±11.5)
Coledale	70 (±0)	-	74.4 (±7.9)	-	89 (±0)
IRH	51 (±23.2)	57 (±17.6)	65.7 (±14.2)	67 (±1.7)	67.5 (±12.5)
Shellharbour	49 (±20.9)	66.7 (±8.0)	66.6 (±13.3)	74 (±12.7)	67 (±14.4)
	p = 0.2764	*p* = 0.4058	*p* = 0.0001	*p* = 0.6465	*p* = 0.0031

The above results reflect the types of patients admitted to Coledale and Bulli Hospitals and are not unexpected. As mentioned previously, Coledale Hospital provides primarily geriatric and rehabilitation services and for these reasons patients from this hospital were not included in the sample. While Bulli does provide acute care services, including accident and emergency and an operating theatre, the hospital also admits patients for respite care and receives patients transferred from IRH, particularly the Wollongong Campus, for convalescence prior to discharge.

In version 1 AN-DRGs, age influenced allocation to only a few classifications, and those DRGs that were split on age were primarily classifying paediatric cases. No age split was above 60 years of age. Therefore, while variations in age that are sufficient to alter the health profile may significantly alter the nature and quantity of resources required during hospitalisation, the small variations between the mean ages of the population in each hospital in

Groups 3 and 5 are unlikely to influence resources and in that sense are not considered to be significant in this study.

7.1.2 Lengths of stay for diabetes and non-diabetes cases

To assess whether the LOS for people with diabetes was longer than non-diabetic patients with similar disorders, 19 AN-DRGs associated with the complications of diabetes were selected for comparison. Table 7-6 compares ALOS in IAHS with National Data. The IAHS discharge data compares the average LOS for the study population with the ALOS for all discharges from the IAHS after the diabetes admissions had been removed. The National Data, which aggregates all episodes assigned to the selected AN-DRGs, was provided by the Casemix Branch of the Commonwealth Department of Human Services and Health.

The data were rounded up or down to the nearest whole number, for example a mean LOS of 2.75 days is recorded as 3 days, and a mean LOS of 1.3 days is recorded as 1 day.

Table 7-6 : IAHS average length of stay 1993-1994 for selected DRGs

DRG		Average LOS (days)		
		IAHS		National
		Diabetes	No diabetes	
034	Specific cerebrovascular except TIA	12	10	16
035	TIA and pre-cerebral occlusion with CC	7	8	8
036	TIA and pre-cerebral occlusion w/o CC	5	6	5
073	Lens age > 9 with CC	2	2	3
074	Lens age > 9 without CC	1	1	2
246	Circulatory disorder w/ AMI w/o invasive cardiac investigations, w/o CC	8	8	8
252	Heart failure	9	8	9
254	Peripheral vascular	7	8	8
259	Syncope and collapse with CC	5	5	6
260	Syncope and collapse w/o CC	2	2	3
270	Unstable angina	6	5	4
329	Oesophagitis, gastro-enteritis and miscell digestive disorders age > 9 with CC	5	5	6
330	Oesophagitis, gastro-enteritis and miscell digestive disorders age > 9 w/o CC	2	2	3
480	Skin graft & debridement PDX skin ulcer or cellulitis	18	14	28
563	Renal failure with CC	8	7	10
568	Infection age > 9 with CC	7	7	8
569	Infection age > 9 w/o CC	9	3	5
578	Other kidney and urinary tract diagnosis age > 9	4	4	4

For the majority of AN-DRGs analysed, there was no difference between ALOS for people with diabetes and the general inpatient population in the Illawarra. In fact, with three exceptions, the ALOS for patients in the Illawarra is equal to, or less than, the National data.

The data did demonstrate that, in this series, patients with diabetes assigned to AN-DRG 270 (unstable angina) had an average LOS that was 2 days more than the national average, and those assigned to AN-DRG 569 (infection age > 9 years without CC) stayed six days longer than other IAHS patients in that class and four days longer than the National data. Cases assigned to AN-DRG 481 (skin graft and debridement, principal diagnosis ulcer or cellulitis) stayed an average of 4 days longer than other patients in the class. However, LOS for cases assigned to AN-DRG 481 in the Illawarra was 10 days less that the LOS for the same category taken from national figures.

7.2 Features of the audit sub-sample

With the exception of patients included in the pilot study and those admitted to the Coledale Hospital, patients listed on the IAHS discharge data base with diabetes as either a principal or a secondary diagnosis, were eligible for inclusion in the chart audits.

A random sample of 386 records was selected from the five groups previously described above for audit. As described in Chapter 6, the records were sorted into ascending order based on the MRN and then grouped according to hospital. The fifth record from each hospital was selected to provide a systematic sample. Fourteen records could not be located or had admissions missing and audits were completed on 386 records. Twenty eight records/177 were from the Bulli Hospital, 290/981 records from the IRH and 68/320 records from the Shellharbour District Hospital.

Table 7-7 : number of records selected for audit, by hospital and group

Group	Bulli	IRH	Shellharbour	Sample total	Group total
1	6	17	5	28	149
2	0	4	0	4	4
3	22	209	48	279	279
4	0	3	7	10	10
5	0	57	8	65	66
Total	28	290	68	386	2094

All of the records assigned to Group 4, diabetes as the only CC, were included in the audit. This was done because it was considered that sampling two or three records in this group would be unlikely to provide adequate data to enable comparisons between these episodes, and those assigned to Group 5 where diabetes was not considered to be a significant secondary diagnosis for assignment purposes.

Table 7-7 shows the number of audits completed in each group at each of the participating hospitals and includes the total number of audits completed for the group.

7.2.1 Comparisons of the sample and audit sub-sample

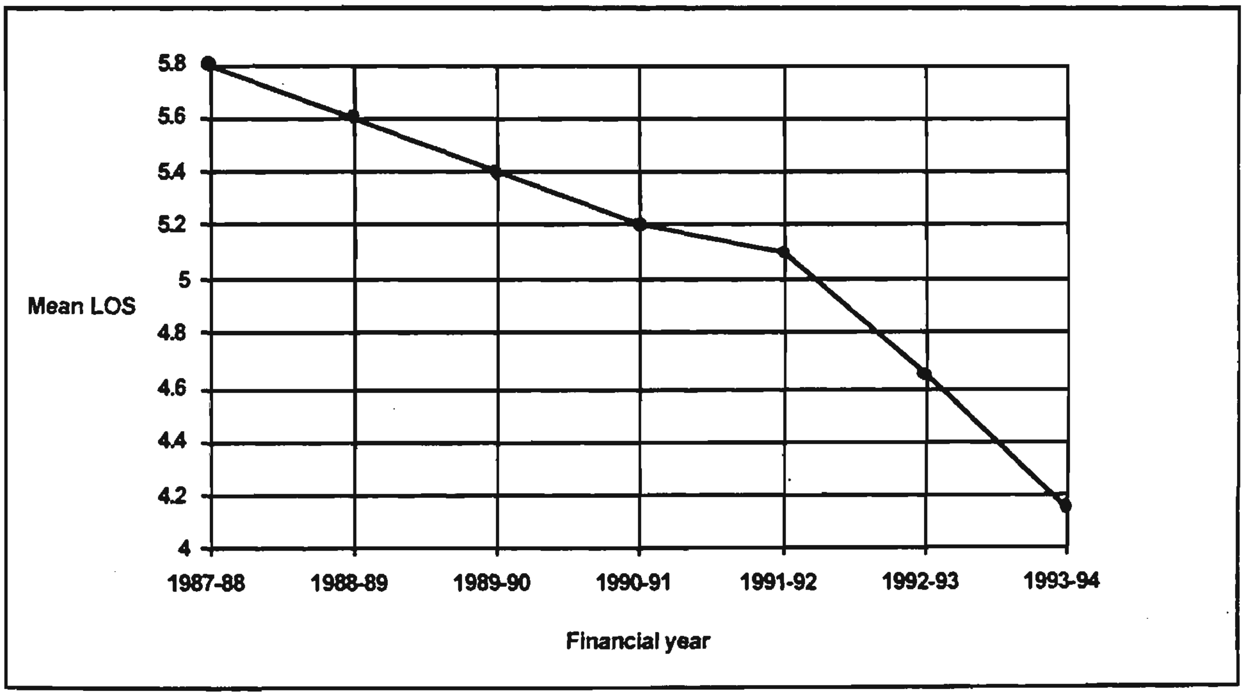
The study population comprised 1136 (52%) females and 1049 (48%) males, with a mean age of 65.9 (±15.3) years (range 2-98 years). The mean LOS for the population was 8.05 (±8.62) days (range 1-93 days).

The sample selected for audit comprised 197 (50.4%) males and 189 (49.6%) females with a mean age of 64.6 (±15.9) years and a mean LOS of

6.08 (±6.12) days (range 1-49 days). There was no significant difference with respect to age or LOS between the population and study groups.

The average LOS for all patients discharged from facilities within the IAHS during the study period was 4.1 days. Each year since 1987 the average LOS for facilities within the IAHS has decreased as shown in Figure 7-1. The Area trend for short LOS needs to be taken into account in the interpretation of the study data and comparison of the study data with other datasets.

Figure 7-1 : average length of stay in days, 1987-1994, IAHS



The sample groups were compared to identify statistically significant differences with respect to age and length of stay. To provide adequate numbers in each group for analysis, the five groups were collapsed into three groups. Groups 1 and 2, diabetes as a principal diagnosis, were analysed together, as were Groups 4 and 5, diabetes secondary diagnosis with CCs. Group 3, diabetes secondary diagnosis without CCs, was analysed alone.

A significant difference was identified between the groups in regard to age (χ^2=15.567, df= 2, p=0.0004) shown in Table 7-8. With a mean age of 49 (±26) years, patients with diabetes as a principal diagnosis (Groups 1 and 2 combined) were significantly younger than those in the Group 3 (χ^2=8.3131, df=1, p=0.0039) and Groups 4 and 5 combined (χ^2=14.129, df=1, p=0.0002). The majority of the episodes assigned to Groups 1 and 2 were coded to 1CD-9-CM code 250.91 (diabetes with unspecified complications). The medical records indicated that hospitalisation was primarily for the stabilisation of uncontrolled diabetes. This would indicate that, in the series of patients studied, management problems for younger patients are associated with acute episodes of high blood glucose levels that require inpatient management. Older patients, on the other hand, are more likely to be admitted as a result of a combination of disorders of which diabetes is one.

Table 7-8 : age (in years) by modified groups

Group	Cases	Mean age in years
1,2	29	49.3 (±26.2)
3	283	64.4 (±14.2)
4,5	76	69.5 (±12.4)

No significant difference was found with respect to LOS for the consolidated groups. Groups 1 and 2 had a mean LOS of 7.9 (5.8) days, Group 3, 5.2 (5.3) days and Groups 4 and 5, 5.88 (8) days.

As previously explained for Table 7-4, a LOS that is significantly above the average for a particular DRG to the extent that the episode of care is identified as an outlier, does impact above reimbursement. Although patients assigned to Group 3 did stay on average three days less than those assigned to the consolidated Group 1 and 2, this is considered to be of little significance. As previously explained, the LOS in the Illawarra Area is low relative to National Data provided by the Casemix Division of the Department of Human Services and Health. Therefore, the finding in this study that LOS is not increased for people with diabetes, should not be generalised to other health Areas. The average LOS is within the range for each DRG therefore the results above would not be considered significant from a reimbursement perspective.

The data were analysed with respect to between-hospital effects. All groups were considered, with the exception of Group 2 which was removed prior to analysis because of insufficient subjects (n=4), to determine whether there was a statistically significant difference between the sample groups selected from each hospital. The differences between hospitals were not significant with respect to either age or LOS.

Another set of analyses examined the differences in age and LOS between the sample and the sub-sample for each group. The level of significance was reached in Group 3 for both age (χ^2=5.5832, df=1, p=0.0181) and LOS (χ^2=23.717, df=1, p=0.0001). With a mean age of 64.7 (±14.4) years, the subsample cases in Group 3 were younger than the sample for that group with a mean of 66.9 (±13.9) years. The mean LOS of 5.17 (±5.29) days, was also shorter than in the sample for the group with a mean of 7.9 (±+9) days.

Spearman's rank-order correlation coefficient (Drew & Hardman 1985:268) was used to test whether there was a relationship between age and LOS for both the sample and subsample in Group 3. While no relationship was demonstrated for the subsample data ($r=0.122$, $r^2=0.014$, $p=0.1226$), a relationship was demonstrated for the sample ($r=0.208$, $r^2=0.043$, $p=0.0001$). This was presumed to be a consequence of the small size of the subsample. Figures 7-2 and 7-3 comprise scattergrams showing the correlation for age and LOS for the subsample and the sample respectively.

Figure 7-2 : correlation of length of stay and age in sub-sample

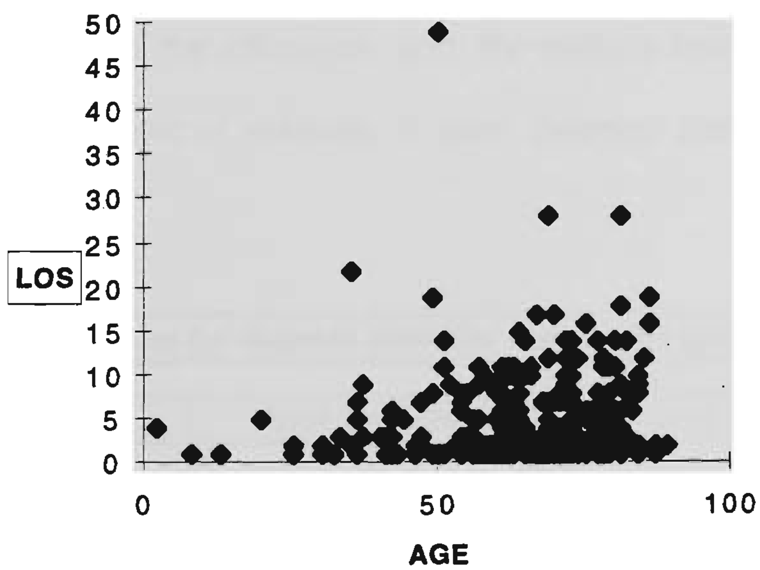
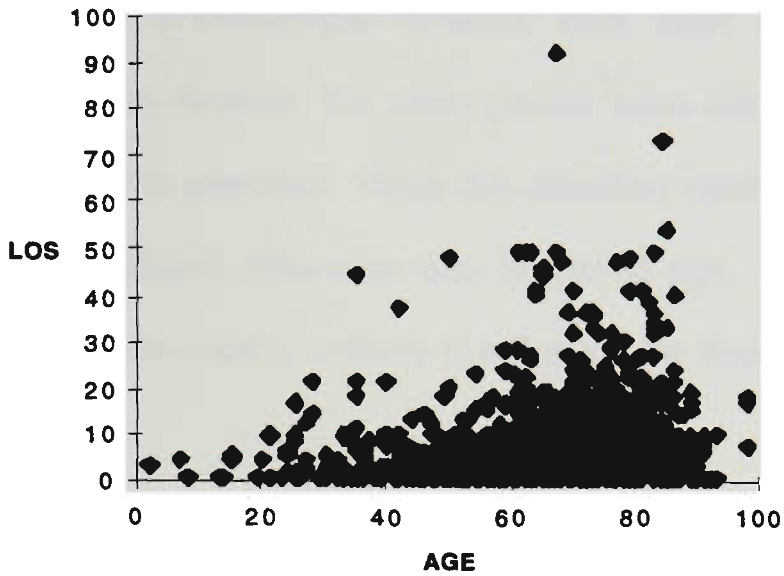


Figure 7-3 : correlation of length of stay and age in sample



The Kolmogorov-Smirnov 2-sample test was used to determine whether the age and LOS of the subsample for Group 3 was representative of the sample from which it was chosen. A significant difference was found in respect to age of the sample and subsample (KS=1.824, p=0.0026), but not for LOS. To determine the nature of the difference, both the sample and subsample were stratified and the percent of subjects in each category identified. Table 7-9 presents these data.

Table 7-9 : age distributions for diabetes identified sample and audit sub-sample

Age in years	Audit sub-sample (%)	Diabetes identified sample (%)
<25	1.4	1.3
25-24	2.2	1.9
35-44	6.1	4.2
45-54	9.7	7.7
55-64	26.2	21.5
65-74	30.1	31.8
>74	24.4	31.7

As stated previously, the study sample was stratified according the DRG logic into five groups and a subsample selected from each group for audit. Although selection was random, the study groups were not further stratified according to age prior to selection. While this selection method has resulted in a statistically significant difference with regard to age, as the analysis demonstrates, this difference is unlikely to influence the findings of the chart audits.

7.2.2 Record audit results

Chart audits were completed on the 386 records selected from the total discharges where diabetes was a diagnosis. Chart audits were completed using the format presented in Appendix 1.

Part (a) in this section investigates how, in these hospitals, diabetes is recorded by clinicians, and coded for DRG assignment. This information will demonstrate the accuracy of the coding, and the usefulness of the data for research. Although this study does not focus on coding per se, this information is important to the overall aim of the study and the testing of the sub-hypotheses.

Part (b) focuses on the clinical interventions that are required to treat diabetes. The clinical interventions are an indication of resource consumption, and therefore the cost of diabetes.

a) Coding of records

The 2094 admissions were assigned to one of 260 AN-DRGs and this diversity means that the pattern of resources use by patients with diabetes as a secondary diagnosis is more difficult to quantify than diabetes as the principal diagnosis. The AN-DRGs most frequently assigned to the study population are shown in Table 7-10.

Table 7-10 : AN-DRGs most frequently assigned to the sample

AN-DRG		Frequency
252	Heart failure and shock	122
529	Diabetes > 35 years	103
270	Unstable angina	86
931	Rehabilitation	73
034	Specific cerebrovascular disorders except TIA	60
432	Medical back problems	49
530	Diabetes < 36 years	47

AN-DRG 529 (diabetes age > 35 years) was the second most frequently assigned class (n=103) and AN-DRG 530 (diabetes < 36 years) was assigned to 47 admissions. Appendix 2 presents a complete list all DRGs assigned to the study sample.

Diabetes was noted as a diagnosis by a doctor in 383/386 (99%) records, however whether the diabetes was considered to be controlled or uncontrolled was documented in only 51/386 (13%) records. Current coding guidelines instruct coders to assign the code for controlled diabetes in all cases where the doctor does not differentiate. Selection of controlled diabetes implies that the patient requires fewer resources. As a result, 245/386 (63%) patients were coded as 'NIDDM unspecified/not stated as uncontrolled'. However, clinical documentation indicated that in some of these cases, interventions consistent with unstable diabetes, for example sliding scale insulin and dextrose intravenous infusions, has been administered. The failure to identify whether the diabetes was controlled or uncontrolled, constitutes inadequate clinical documentation, and fails to reflect the actual resources used.

Non-Insulin Dependent Diabetes or IDDM was coded as a secondary diagnosis in 366/386 records (study Groups 3 to 5). A diabetes related complication was identified as a secondary diagnosis in only six records. Comorbidities were coded to be manifestations of diabetes in only 19/386 (5%) records accounting for 30 manifestations.

The most frequently coded manifestations were retinopathy (ICD-9-CM code 362.01) n=6; polyneuropathy in diabetes (code 357.2) n=3 and nephritis and nephropathy in diseases classified elsewhere (code 583.81) n=3. During the audit an additional 46/386 (12%) records were identified where a secondary diagnosis, consistent with, and in several instances identified to be the result of diabetes, had been coded to a non diabetes code. These secondary diagnoses had been coded to peripheral vascular disease unspecified, gangrene, renal disorders, syncope (in a record where hypoglycaemia had been documented by the physician) and cataract (cataract resulting from diabetes had been identified in the admission letter). Appendix 3 lists the secondary diagnosis codes of the study sample for all groups and the documented manifestations are listed in Appendix 4.

These results demonstrate that the majority of people with diabetes as a secondary diagnosis have NIDDM, as opposed to those with diabetes as a principal diagnosis, where IDDM was more common. These people are also older and, although diabetes related complications are the reason for admission in some cases, the association between diabetes and the complication is usually not made in either the clinical documentation or the coding.

The Student's 't' Test was used to determine whether there was a significant difference in the length of stay between patients with diabetes listed as a secondary diagnosis and those where the manifestation had been identified as a complication of diabetes and coded as such. No significant difference was found (p=0.0890).

The records confirmed that 334/386 (86%) patients received treatments for the management of diabetes during the episode of care under review. However, in only 220/386 (57%) records were all of the diagnoses (both diabetes and non diabetes), coded according to the care given. In 161/386 (41%) records a treatment was given for one or more diagnoses that were not coded, and in 44/386 (11%) records a diagnosis was coded although no treatment was given. Appendix 5 presents a complete list of the ICD-9-CM codes for the uncoded diagnoses, and Appendix 6 presents a list of the codes for the diagnoses coded but not treated.

In 91/386 (23%) records, the principal diagnosis was changed after reabstraction (Appendix 7). Of the diabetes-specific codes, 172 were changed in 123/386 (33%) records; 23 principal diagnosis, 122 secondary diagnosis and 27 procedure codes. While the code changes were not verified by a second coder, the changes could be significant because DRG data is used for both reimbursement and research purposes. The fact that one third of the diabetes codes were changed could be a reflection of the complexity of diabetes, and /or a lack of understanding of how the codes should be applied. The preferred codes are listed in Appendices 8, 9 and 10.

Diabetes was confirmed as the principal diagnosis for all records assigned to Groups 1 and 2. However, of the 32 records, 15 required a code change (13 in Group 1 and 2 in Group 2). The code change was primarily related to the use of the 5th digit identifying IDDM and NIDDM and the 4th digit in those cases where complications were present. In the majority of instances, failure of the doctor to accurately record whether the patient had IDDM or NIDDM, and/or associate a complication with diabetes was found to be the cause. This finding may indicate that doctors are not aware of the level of detail required for coding or that other factors impact upon the accuracy of their documentation.

Codes for the principal diagnosis of two records in each of Groups 3 and 5 (diabetes as a secondary diagnosis) were changed to diabetes as the principal diagnosis. Because these code changes were related to the principal diagnosis, the assigned DRG was subsequently incorrect according to the reabstracted coding.

The documented principal diagnosis or procedure reflected the care that was recorded in 330/386 (85%) of audits and the documented secondary diagnosis reflected the care that was given in 253/386 (65%) records. A 'yes' response for these items was given even if the patient was seen by the diabetes educator or dietician or had routine ward blood glucose monitoring. Although no record was coded to reflect these interventions, to mark those records as 'no' would result in almost no record accurately reflecting the management of secondary diagnoses. Table 7-11 summarises results associated with coding of diabetes.

Table 7-11 : summary of results of coding for diabetes

Attribute	% of records in the audit subsample
Identified diabetes manifestations	5
Diabetes influenced treatment	86
All diagnosis listed according to care	57
Treatment for a diagnosis not coded	41
Diagnosis coded and not treated	11
Code change for diabetes	33
Principal diagnosis reflects care given	85
Secondary diagnosis reflects care given	65

Frequent errors in the coding of diabetes were due to misclassification of IDDM and NIDDM and coding to uncomplicated diabetes when complications of diabetes, including unstable blood glucose level, had been identified by the clinician. To aid decision making for the chart audits, clinical criteria was used to determine whether the type of diabetes (NIDDM or IDDM) had been correctly identified. A patient was considered to be IDDM according to the criteria determined by Welborn, Garcia-Webb, Bonser, McCann & Constable (1983).

The secondary diagnosis for diabetes was identified in the 354 records allocated to groups 3, 4, and 5. Of these, the codes assigned to secondary diagnoses were changed in 71/354 (20%) records. The changes were primarily because of misclassification of IDDM or NIDDM and/or allocation of the 4th digit code for uncomplicated diabetes when complications of diabetes had been identified by the clinician.

Additional treatments were given for a diabetes related condition that had not been coded in 142/354 (40%) records. In 15/354 (4%) records, a conflicting diagnosis that was not diabetes related was found, and a treatment not related to diabetes was left uncoded in 26/354 (7%) records.

Diabetes was not documented by the clinician on the discharge summary of four records, while three records had been coded diabetic although no documentation of diabetes was found in the file. In 211/354 (54%) of records a conflicting diabetes diagnosis was documented, for example, uncomplicated diabetes was coded while 'stabilisation of diabetes' was documented in the records.

These findings indicate that the data would be of little use for prevalence studies of IDDM and NIDDM, and that the intensity of resources used to manage diabetes is underestimated. The results are summarised in Table 7-12.

Table 7-12 : documentation errors, diabetes

Error type	Frequency
Misclassification of diabetes	71
Additional treatments for diabetes not coded	142
Conflicting diagnosis (not diabetes)	15
Diabetes not noted on discharge summary	4
Non diabetes treatment not coded	26
Diabetes coded and not diabetic	3
Conflicting diabetes diagnosis (includes complications and stabilisation)	211
Secondary diagnosis reflects care given	65
n = 354	

There were 4 records where the principal diagnosis was changed during the reabstraction which had been assigned to a non-diabetes DRG. The recommendation of expert medical opinion was to recode the episode of care to a principle diagnosis of diabetes. These records were coded as follows:

a) Record 1 coded to ICD-9-CM classification 790.6 (other abnormal blood chemistry) for a patient with hyperglycaemia although the admission record stated that the patient was admitted for restabilisation of diabetes.

The principal diagnosis code was changed to 250.91, diabetes with unspecified complication, IDDM. Following reabstraction, AN-DRG 932 was changed to AN-DRG 530 (diabetes <35 years).

b) Record 2 coded to ICD-9-CM classification 305.00 (alcohol abuse) although the admission record stated that admission was for restabilisation of diabetes. The principal diagnosis code was changed to 250.90, diabetes with unspecified complications, NIDDM. Following reabstraction, AN-DRG 854 was changed to AN-DRG 529 (diabetes > 35 years).

c) Record 3 coded to ICD-9-CM classification 787.0 (nausea and vomiting). The admission records noted that the blood glucose level was 22 mmol/l (normal range 3.5-5.5 mmol/l), that the patient was dehydrated, had complained of blurred vision (signs of elevated blood glucose level) and that the admission was for restabilisation of diabetes. The principal diagnosis code was changed to 250.90 diabetes with unspecified complications. Following reabstraction, AN-DRG 329 changed to AN-DRG 529 (diabetes > 35 years).

d) Record 4 coded to ICD-9-CM classification 599.0 (urinary tract infection site not specified). The admission record noted that the patient was admitted through Accident and Emergency to '...correct dehydration and elevated blood glucose.' which required intravenous dextrose infusions and sliding scale insulin to correct the high BGL. The urinary tract infection was treated with antibiotics. The principal diagnosis was changed to 250.90 diabetes with unspecified complications. Following reabstraction, AN-DRG 568 was changed to AN-DRG 529 (diabetes > 35 years).

These case studies demonstrate the problems arising from the necessity to identify one principal diagnosis and the difficulties coders experience when clinical documentation is neither precise nor accurate. Problems associated with the coding of diabetes-related diagnoses appear to be partly a consequence of weaknesses in clinical documentation, but they are also presumably a reflection of the inherent complexity of diabetes as a disease process. Documentation problems included lack of specificity of diseases and their comorbidities, illegible progress reports, conflicting information/diagnosis, use of non regulation abbreviations, and failure to clearly identify the principal diagnosis.

While the onus is on the coder to consult with clinicians concerning discrepancies in the documentation, practical difficulties militate against that course of action. Tight coding deadlines, lack of immediate access to clinicians, response delays, and the coders' inclination to accept without question the clinician's stated diagnosis, all seem to contribute to coding errors. This situation is exacerbated by the difficulties coders experience when attempting to make coding decisions in complex episodes of care.

b) Management of diabetes

One hundred and fifty/386 (39%) patients had a procedure performed, and in 13/386 (3.4%) records the surgery was attributed to a diabetes related condition. Twenty four (6%) patients experienced at least one post-operative complication clinically associated with diabetes, for example, short term insulin and an intravenous glucose infusion for restabilisation of diabetes, wound breakdown, delayed healing and post operative infection. Overall, 81/386 (21%) of patients received insulin therapy, and many also received intravenous dextrose for the restabilisation of blood glucose levels.

Only 52/386 (13%) patients did not receive some form of treatment for diabetes during hospitalisation and only two patients, both with diabetes as the principal diagnosis, did not have a secondary diagnosis recorded on the discharge summary.

Routine blood glucose monitoring in the ward was performed for 332/386 (86%) patients. The usual hospital routine for people with IDDM is before and after each meal and after supper at night. Patients with NIDDM are usually tested after each meal. Throughout the IAHS, the Reflolux 11 meters distributed by Boehringer Mannheim Australia P/L were used for routine ward monitoring during the study period. In the hands of a skilled operator, each test takes approximately three minutes from commencement of the test until recording of the results. This intervention requires 20-25 minutes per patient per day however, as the majority of patients in this study are assigned to a

DRG where diabetes is not considered to be a significant CC, the staff resources required to complete this intervention are unlikely to be taken into account for casemix-based funding.

Of the 386 patients, 244 (63%) received education from a specialist diabetes educator during hospitalisation, 77/386 (20%) were referred to a diabetes educator for review following discharge and 153/386 (40%) had a consultation with a dietician during hospitalisation. Although visits by the diabetes educator and/or dietician were never coded, these omissions have not been included in the data describing coding errors. Although provision does exist for coding of education (V65.3, dietary surveillance and counselling, and V65.4, other counselling, not elsewhere classified) no record had been coded to account for those resources. Strictly speaking, costing studies are required to prove this in a rigorous manner.

Virtually all records had these interventions and to identify those records as incorrectly coded would mean that only a few records had all of the codes for diabetes correct according to the resources used. As a result of this coding oversight, there is no indication in the records that the Diabetes Education and Information Unit, for which the IAHS allocates an annual budget of $400,000.00, operates within these hospitals.

Of the 386 patients reviewed, 53 who were not admitted by a specialist physician were referred to one during hospitalisation for a diabetes-related consultation and 58/386 (15%) patients were referred to community health for post discharge follow up. Table 7-13 summarises these results.

Table 7-13 : diabetes related managements

Treatment	Frequency
Seen by diabetes educator	244
Seen by a dietician for diabetes	153
Seen by a physician for diabetes	53
Ward monitoring of blood glucose	332
Insulin or dextrose	81
Referral for outpatient education	77
Referral to community health	58

The use of pathology and diagnostic resources by the patients was also reviewed. Three hundred and sixty nine patients (96%) had one or more pathology or diagnostic service. Specimens from 172 patients were tested for microbiology, 319 patients for biochemistry, predominantly for estimation of blood glucose level, 317 patients for haematology, eight for cytology, 255 for X-ray, 256 for diagnostic tests, predominantly electrocardiograph, and 27 for pathology associated with surgery (for example histopathology).

With the exception of those episodes where diabetes was a principal diagnosis (n=149), and those where diabetes was a significant CC (n-10), the cost of the biochemistry for estimation blood glucose levels would not be reimbursed. The estimated cost of the consumables used to estimate a blood glucose level is approximately $10 (personal communication from Department of Biochemistry, IRH).

This amounts to around $1600 in unreimbursed services for these patients. If this was an isolated cost, the impact upon the Area Health Service would be negligible. However, it is reasonable to expect that the accumulated impact of all of the 'hidden', and probably unreimbursed, costs across the Area over a year would be significant.

7.3 Classification performance in terms of LOS homogeneity

This stage of analysis involved computation of the effectiveness of the AN-DRG classification in terms of explanation of the variance in length of stay in the diabetes identified sample. For these analyses, all 2178 records containing diabetes diagnosis codes were included. These records were distributed among 210 DRGs.

Four classification models were tested, as summarised in Table 7-14. The first was generated empirically by the PC-Group AID package, where the only restriction was that there should be no more than 8 final classes, and each must comprise one or more DRGs.

Table 7-14 : four classification models, diabetes cases (diabetes identified sample)

	Classification model	Number of groups	R^2
1	Statistically optimal groupings of DRGs, DRGs < 3 cases excluded	6	28%
2	All DRGs forming own group	210	33%
3	All DRGs forming own group, DRGs < 3 cases excluded	159	31%
4	Trial logical solution	8	32%

This gave an R^2 value of 28% with the six final classes whose attributes are shown in Table 7-15. Note that the selection of a constraint of 8 classes was somewhat arbitrary, excepting that one might expect a significant solution to have no more than this number of classes for the size of the sample available here. In the event, there was hardly any change in the solution for any number of classes between 5 and 20.

Table 7-15 : group attributes for model 1 (maximisation of R^2 for up to 8 DRG groupings)

Subgroup	Cases	% Cases	Cells	Sum Sq	Mean LOS	SD LOS
1	274	12.6	34	828	2.29	2.6
2	547	25.1	62	5621	5.28	5.3
3	887	40.7	62	40618	8.01	6.7
4	267	12.3	34	22785	11.2	9.2
5	112	5.1	14	8899	15.3	8.9
6	91	4.2	4	26904	24.2	17.3
All	2178	100.0	210			

The column headed 'Cases' reports the number of discharges in the DRGs assigned to each subgroup (or class). The proportion of discharges in each subgroup is shown in the column headed '% Cases'. The number of different DRGs assigned to each subgroup is shown in the column headed 'Cells'. The mean length of stay and the standard deviation of length of stay are shown for each group in the last two columns.

Performance was only improved marginally for model 2, where every DRG was required to form its own subgroup. The resultant model, with 210 final classes, was able to explain only 33% of the variance in length of stay.

For the third of the models listed in Table 7-14, the analytical database was reduced to 2120 by the exclusion of all cases in AN-DRGs with fewer than three observations. Under this scenario, the numbers of DRGs was reduced to 159. As expected, there was little change: R^2 declined from 33% to 32%.

The fourth model involved the application of a little clinical knowledge. In brief, this model simply took the obvious splits in the DRG classification (the two diabetes classes, DRGs 529 and 530; and the cases assigned to medical and surgical DRGs, with and without CC splits) to give six initial categories. Then the rehabilitation DRG (931) was isolated, and finally all same-day cases were defined to be the eighth group. The results are shown in Table 7-16.

This simple solution explains 32% of the observed variation in length of stay in the sample, with only eight final classes. In short, it performed relatively well, and was better overall than the DRG model itself (in that it gave roughly the same variance reduction with only a fraction of the final classes.

Table 7-16 : diabetes classification model 4 (a simple clinical model)

Subgroup	Cases	% Cases	Mean LOS	SD LOS
Med	789	36.2	8.1	5.8
Medcomp	368	16.9	11.4	9.5
DRG 529	95	4.4	8.3	6.8
DRG 530	40	1.8	5.2	3.0
Rehab	75	3.4	24.5	17.2
Surg	271	12.4	6.8	7.1
Surgcomp	124	5.7	14.9	9.3
Sameday	416	19.1	1.0	0.0
All	2178	100.00	8.0	8.6

Subgroup label	*Definition of Subgroup*
Med	*Cases assigned to medical DRGs, LOS > 1 day*
Medcomp	*Cases assigned to medical DRGs with CC, LOS > 1 day*
DRG 529	*Cases assigned to DRG 529, LOS > 1 day*
DRG 530	*Cases assigned to DRG 530, LOS > 1 day*
Rehab	*Cases assigned to DRG 931, LOS > 1 day*
Surg	*Cases assigned to surgical DRGs, LOS > 1 day*
Surgcomp	*Cases assigned to surgical DRGs with CC, LOS > 1 day*
Sameday	*Cases with LOS = 1 day*

Model 4 is of interest, because it suggests there is the potential for improvement. The results are not surprising, and the main cause of improved performance is not related specifically to diabetes (but is the result of separation of rehabilitation and same-day cases). However, it is surprising that, after 25 years of development, the performance of the DRG classification is hardly far in advance (and possibly behind) the simplest of classifications when the focus of interest is a major disease like diabetes.

Several reasons for this low predictive power are proposed. The first is the inability of the DRG logic to take account of all CCs. Current DRG assignment recognises only those CCs that are considered to have a significant impact upon the LOS for selected principal diagnoses. It is possible that patients with disorders such as diabetes are likely to have much longer lengths of stay and treatment costs than for many other conditions defined to be CCs.

The inability of the current DRG logic to account for variation in severity between cases assigned to the same DRG is another factor that could reduce the homogeneity of the resulting groups. The predictive power of the principal diagnosis or main procedure is likely to be higher for acute disorders than for chronic conditions.

One obvious limitation of the analyses is use of length of stay as the indicator of cost. There are many other case types where one might expect a significant difference in optimality if a more precise measure were applied. In the case of diabetes, it would be reasonable to expect that people with diabetes-related complications require more resources to treat. In this sample, it has been noted that there was no difference in the LOS of patients with and without complications. The reliance on LOS as a predictor of resources consumed fails to take account of changing clinical practice including the introduction of new technology, which can result in increased intensity of care.

Further research is required. Some possibilities for improved assignment logic are presented in Chapter 8.

7.4 *Analysis of the sample diabetes not identified*

As noted above, a search was made of the records of the Diabetes Education and Information Unit (DEIU) of the IAHS, in order to identify clients who had been admitted to the IRH Wollongong Campus during the period from 1 July 1993 to 31 December 1993 and for whom a diabetes diagnosis did not appear in the IAHS discharge data base. This convenience sample was chosen because records at the DEIU do not allow computerised comparison with inpatient records at the IAHS. This situation arises because the DEIU is an ambulatory service and administered by the Community Health Services rather than by an inpatient facility.

After women with gestational diabetes mellitus were excluded, 22 patients with diabetes were identified. The records were retrieved and an audit completed using the instrument in Appendix 1 (Coding of Diabetes - Chart Audit), which was also used to audit records where diabetes was identified.

The main findings from the audit are listed in Table 7-17. Diabetes was not identified as a diagnosis by the doctor on 6 of the 22 records, and this was the cause of the omission in the discharge record. On a further six records, diabetes had been noted by the doctor, but not coded by the coder. In five of the records where diabetes was coded, the diabetes codes were sequenced low down an extensive list of multiple diagnoses. As a result, a diabetes code did not appear on the discharge database (because of the local rule which limits coding to a maximum of 10 secondary diagnoses).

A total of 175 diagnosis codes were listed for the 22 episodes of care, which is an average of 7.95 diagnoses per patient. There were high numbers of secondary diagnoses. There was one patient with each of 12, 15, 20, and 23 diagnoses, and two patients had 28 diagnosis codes listed.

In one of the records with 28 coded diagnoses, a physician had documented 'diabetic small vessel disease' but this did not appear on the discharge summary. The principal diagnosis for this admission was identified as ICD-9-CM code 682.6. (other cellulitis and abscess, leg except foot) which is clinically associated with vessel disease in people with diabetes. This coding did not reflect the clinical documentation which reported gangrene and a partial amputation of the foot.

The patients ranged in age from 11 to 89 years (59 ± 18.7). Length of stay ranged from three to 70 days (13.3 ± 13.9). The 70-day stay was an outlier: when this record was removed, the range fell to three to 24 days (10.6 ± 5.9). Nine cases were male and 13 were female.

The principal diagnosis reflected the care given in 18 of the 22 records. However, the secondary diagnosis reflected the care in only 10 records. Only one record had no secondary diagnoses listed. Only 8 records were judged to have a complete record of diagnoses as defined by the national coding guidelines.

Treatment was given for a diagnosis that was not coded in 14 of the records, while there were only two records where a listed diagnosis was not treated. Fourteen patients received additional treatments for diabetes that were not coded. In six records, a treatment that was not for diabetes was also not coded. Following reabstraction, the principal diagnosis was changed on four records.

Table 7-17 : coding for diabetes (diabetes not identified)

Response	Frequency
Principal diagnosis reflects care given	18
Secondary diagnosis reflects care given	10
All diagnosis listed according to care	8
Treatment for a diagnosis not coded	14
Diagnosis coded and not treated	2

n=22

Table 7-18 summarises the diabetes-related treatments provided to patients in the sample. Twenty were provided with pathology or diagnostic services, 19 patients had microbiology, 20 had biochemistry, 20 had haematology, and 17 had X-ray and/or diagnostic investigations such as electrocardiography. These patterns of treatment are consistent with the complex nature of the episodes of care described in these records. Nineteen patients received routine ward blood glucose monitoring, four received intravenous glucose, and four received sliding scale insulin.

Sixteen patients had a consultation with a diabetes educator. Eighteen were referred to a dietician, and four were referred to a physician for a diabetes related consultation. Four patients were referred to community health for follow up after discharge, and eight were referred for diabetes education after discharge. The presence of diabetes increased resource use in 20 of the 22 cases. In a subset, the level of consequent resource use was extremely high.

Table 7-18 : diabetes related managements (diabetes not identified)

Treatment	Frequency
Ward monitoring of blood glucose	19
Sliding scale insulin	4
Dextrose infusion	4
Consultation with a diabetes educator	16
Consultation with a dietician for diabetes	18
Consultation with a physician for diabetes	4
Referral to community health	4
Referral for outpatient education	8
Diabetes increased resources	20

n=22

Eleven patients had a surgical procedure, which in one instance was for the management of peripheral vascular disease associated with diabetes. All of these patients had a post-operative complication listed in the record. They included sepsis, haemorrhage, hypoglycaemia, wound breakdown, deep venous thrombosis, and urinary retention.

The principal diagnoses included complex procedures for malignancy, and vascular surgery (including cerebrovascular procedures). One case was assigned to AN-DRG 950 (extensive OR procedure unrelated to PDX which has a cost weight of 2.36).

Other DRG assignments included DRG 563 (renal failure with CC, cost weight 1.79), DRG 252 (heart failure and shock, cost weight 1.35), and DRG 034 (specific cerebrovascular disorder, cost weight 2.80). For comparison, DRG 529 (diabetes aged > 35 years) has a cost weight of 1.22, and DRG 530 (diabetes < 36 years) has a cost weight of only 0.98.

The ALOS for all episodes in the group where diabetes was not identified was 10.6 (± 5.9). By comparison, the ALOS for all episodes in this study where diabetes was identified was 7.9 (± 5.8) days.

The restriction to 10 coded diagnoses for computer abstraction is potentially dangerous for patients with diabetes. It can reasonably be argued that this is irrelevant if the objective is correct DRG assignment. If coders take care in sequencing, the risk is indeed minimal, since DRG assignment is determined by the principal diagnosis or procedure, and the highest ranking secondary diagnosis. This does not, however, eliminate the concern. If the DRG logic only counts one other diagnosis, then there is reason for concern about the way it categorises episodes for patients with a disease like diabetes. The main objective is surely that of precise recording rather than merely the correct assignment to a DRG.

Although it is not possible to generalise from the small number of episodes audited in the group where diabetes was not identified, it would appear that these patients constitute a discrete group of low volume, complex disorders.

Further research would be required to determine whether the DRG assignment of these cases accurately reflects the resources that are consumed during the admission.

7.5 Summary of analyses

The DRG classification was designed to classify acute admissions to short-stay hospitals, and there is reason to believe it meets the requirements in an efficient way. There is, however, good reason for concern about the way in which it categorises patients with diabetes.

This study examined DRG assignment for the complete cohort of 2178 cases with diabetes treated in the IAHS hospitals in 1993-94. It was found that the DRG classification, in spite of the large number of classes to which diabetes patients can be correctly assigned, explained only 28% to 33% of the variance in length of stay for the complete cohort of cases studied. The maximum value was obtained when every DRG was allowed to constitute its own class, thus producing 210 terminal nodes.

When classes were restricted to a reasonable number, relative to the size of the study database, a better result was obtained by definition of a simple six-part classification. These results suggest there is considerable potential for improvement, at least with respect to diabetes patients.

The concerns were amplified by the results of the chart audits for a subsample of the diabetes records. It was found that diabetes influenced the care provided during the admission in 87% of the cases where diabetes had been recorded in the discharge abstract. However only 48% of the records had been assigned to an AN-DRG with CCs.

Of equal importance, the large majority of assignments to with-CC classes were not affected by the diabetes diagnoses themselves. In only 10 of the 184 cases of assignment to a with-CC class was the diabetes diagnosis the only significant secondary diagnosis and thereby the cause of the assignment.

The DRG logic is dominated by the principal diagnosis or the main procedure, and secondary diagnoses are hardly used to their full potential. For chronic conditions like diabetes, one obvious consequence is that of under-reporting of the clinical complexity and under-estimation of the costs of care.

The concerns are not reduced by the evidence of imprecision in abstracting, sequencing, and coding of cases with diabetes. The selection of principal diagnosis was not found to be a major concern. However, it is worth noting that, of the 32 records in the diabetes DRGs (529 and 530), 15 required a code change. For the most part, this was the result of incorrect specification of the diabetes condition.

Codes for the principal diagnosis of two records in each of Groups 3 and 5 were changed to diabetes as the principal diagnosis. These four code changes, which altered the assigned DRG, were made following expert opinion from a diabetologist who was not associated with the patients or the study. These discrepancies in the assigned codes are a reflection of the complexities of diabetes, and the diversity of episodes to which the diabetes codes can be applied. The situation is compounded when, largely for the reasons noted above, clinicians fail to provide accurate and precise clinical reports, and the coding guidelines are indecisive.

The more important data errors related to the presence of diabetes as a significant comorbidity. In at least 48 audits, errors in clinical documentation and/or coding resulted in significant manifestations of diabetes being incorrectly coded. There was evidence of treatment for diabetes in respect of 157 secondary diagnoses that were not coded. Furthermore, diabetes influenced the care of 334 patients in the diabetes identified sample and 20 patients in the diabetes not identified sample. However, diabetes influenced assignment in only 50% (184) of these cases. Of the 184 cases, diabetes was the principal diagnosis for 174 admissions, and it was considered to be a major CC in the remainder.

One hundred and twenty-two codes for secondary diagnosis were changed during the audit. In a few instances, hospitalisation was primarily for management of the diabetes related complications (such as cataracts, peripheral vascular disease, hypoglycaemia and hyperglycaemia). However, in the majority of records where diabetic complications were present, the coding did not connect the diabetes with the complication.

In summary, there appear to be opportunities for improved effectiveness of the DRG classification with regard to diabetes. Its presence is under-reported and has an apparently underestimated effect on resource use. The difficulties are compounded by relatively poor discharge summaries. However, the magnitude of the problem (and the possibilities for improvement) may be difficult to determine until better data are available for a large and appropriately representative sample.

CHAPTER 8

DISCUSSION OF RESEARCH FINDINGS

STATISTICAL PERFORMANCE OF THE AN-DRG CLASSIFICATION

ISSUES RAISED BY THE CHART AUDIT

POTENTIALLY USEFUL IDEAS IN OTHER CLASSIFICATIONS

SOME IDEAS FOR REFINEMENT IN DIABETES CLASSIFICATION

OTHER ISSUES RELATING TO THE DRG CLASSIFICATION

LIMITATIONS OF THE STUDY

IMPLICATIONS FOR RESEARCH AND DESIGN

SUMMARY

Chapter 8 Discussion of research findings

In outline, this study supports many of the findings of related studies. The sample of records was little different in its main attributes. For example, there were 149 discharges assigned to the diabetes DRGs (529 and 530), representing 0.33% of the total of 45679 discharges from acute care hospitals in the Illawarra Area Health Service between 1 July 1993 and 30 June 1994. This compares with the national proportion of 0.36% (11845 in 3.26 million discharges) in public hospitals in the same period.

National statistics were not available for the same period, with respect to the number of discharges with diabetes as a secondary diagnosis. However, other studies have indicated similar levels to those in the sample reported here, at around 4% to 6%.

This is consistent with epidemiological data which show that 5% of the Australian population have been diagnosed as diabetic. Diabetes is reported to be a significant cause of hospitalisation in Australia. Hospitalisation is often for the management of diabetic complications including heart attack, stroke, diabetic neuropathy, amputations of lower limbs, blindness and renal failure (McCarty et al. 1996).

However, international data indicate that there tends to be under-reporting of the rate of hospitalisation of people with diabetes as a secondary diagnosis

(Williams 1985; Leslie 1992; Rubin et al. 1994). One cause is abstraction and coding: research has shown that inaccuracies in the coding of diabetes as a principal or secondary diagnosis results in an underestimation of the significance of the disorder amongst people in hospitals (Connell et al. 1984; Williams 1985).

There are few Australian data on these issues. However, it would not be unreasonable to expect that the prevalence of diabetes amongst the hospitalised population would exceed that of the general population. It was not possible in this study to measure precisely how many people with diabetes were admitted to hospital during the study period but not recorded as having the disorder. However, Leslie et al (1992) found that in an unselected prospective study, omission of the ICD-9 codes for diabetes occurred in 61% of admissions by people with diabetes.

DRG assignment for episodes of care included in this study was according to version 1 of the AN-DRG classification which contains 527 final classes. Many (but not the majority of) diagnosis and procedure clusters are split into two final classes: with CCs and without CCs. The definition of the significance of a secondary condition (which qualifies it as a complication or comorbidity) relies on length of stay effects as the indicator of increased cost. However, the validity of LOS as a proxy for resource consumption has long been questioned, and the concerns are increasing for several reasons including the fact that the continuing decline in length of stay is associated with increased intensity of care for some but not all case types (ACCC 1994b; Hickie 1994). This study supports the argument that diabetes as a secondary condition is too frequently ignored as a potential CC. It also supports the argument that the counting of a maximum of one secondary diagnosis is generally illogical, and of particular concern where the condition is one like diabetes (where multiple effects are the normal consequence of the disease).

In summary, this study supports other Australian and international work which has found that weaknesses in the logic of the DRG classification are further compromised by poor clinical documentation (Currie 1985) and coding errors (Connell et al. 1984; Reid 1991; Holman 1994). As a result, data may be significantly flawed if their intended use is health care funding (Donoghue 1992) or even morbidity and mortality estimations (Mullin 1985). The risks of minor errors are large, given the absolute magnitude of the disease: inpatient care for people with diabetes in the USA is estimated to cost around US$68 billion annually (Rubin et al. 1994) and A$1300 million in Australia (Diabetes Australia 1988; McCarty et al. 1996).

8.1 Statistical performance of the AN-DRG classification

As reported in Chapter 7, the AN-DRG version 1 logic was able to explain between 28% and 32% of the variations in length of stay for discharges with one or more diabetes diagnoses. Performance was little changed when the full set of 527 final classes was used. A simple clinical model, whereby DRGs were assigned to a small number of classes, performed equally well.

These results are similar to those obtained in several other studies. For example, Bender and McGuire (1995) found that the length of stay variance reduction (LOS RIV) for all AN-DRGs is approximately 40%, but there are large differences between MDCs. For example, AN-DRGs in MDC 17 (neoplasms) have an RIV of 68%, and a similar value is obtained for MDC 6 (digestive system disorders). MDC 10 (endocrine disorders) had the second worst performance in terms of LOS RIV.

The poor performance of the AN-DRG assignment in MDC 10 is not unexpected. Endocrine disorders are, with hardly any major exceptions, chronic conditions that manifest in a variety of complications. As a result, it is difficult to identify the 'average' patient, or to map in advance an expected course for hospital episodes.

Methodological differences between this study and that of Bender and McGuire (1995) militate against valid comparisons in terms of the RIV values themselves. The main problem is that the latter study used statistical methods to exclude exceptional cases. The authors defined outliers for trimming purposes as "... episodes that bear little resemblance to other episodes within the casemix group to which they are assigned."

It is unclear what purpose was intended to be served by removal of unusual (or poorly described) episodes from the analysis, other than to ensure that a higher RIV could be reported. They might reflect data errors, or they might simply point to problems in classification logic. There seems little doubt that trimming, which is a common tool, serves to divert attention from what might be high priority problems of classification logic.

8.2 Issues raised by the chart audit

It has been found that the AN-DRG classification performs in a relatively unsatisfactory way for cases with diabetes. The weaknesses were indicated by the statistical analysis of length of stay variance, and subsequently confirmed in some respects by the chart audits as summarised below.

8.2.1 Issues of DRG logic

This study brought into focus the nature and intensity of resources used by people with diabetes during hospitalisation and, in doing so, the results reiterate weaknesses in the DRG logic and guidelines identified by others. The findings of the chart audit were consistent with previous studies which demonstrated problems with the DRG logic and limitations of the classification. The reported problems related to identification of the principal diagnosis (Connell et al. 1984; Roberts et al. 1985; Iezzoni & Moskowitz 1986), the adequacy of codes for secondary diagnosis (Mullin 1985; Hindle et al. 1990; Iezzoni et al. 1992), and errors in coding and/or clinical documentation (Lloyd & Rissing 1985; Reid 1988; Reid 1991; Donoghue 1992; Holt & Anderson 1992). The key conclusion which might be drawn is that the AN-DRG classification has limited ability to describe episodes of care in a coherent way for some groups of patients (Eagar 1995).

One underlying problem is that the DRG logic has been driven to a considerable extent by the definition of homogeneity based on length of stay, and this presents serious risks where the intensity of care is variable. Some researchers including Williams (1985) have found that LOS has been increased for patients with diabetes, this was not the case for the sample studied here. The average LOS for patients in the study was 6 days compared to 4 days for all patients in the Illawarra. However, when the LOS for individual AN-DRGs was reviewed, the values for people with diabetes did not differ significantly from the population at either a local or national level. Technology has simplified diagnostic and surgical procedures and the 'hospital in the home' has enabled complex care to be provided in non-institutional settings. As a result, relatively short stays can result in intensive management with costly resources. Therefore, other variables such as clinical indicators, would provide a more accurate indication of resource consumption than does length of stay by itself.

Diabetes influenced DRG assignment for only 184/2185 (4.8%) patients, 174 with diabetes as the principal diagnosis (Groups 1 and 2), and 10 where diabetes was a secondary diagnosis (Group 4). However, 334 (86%) of the records that were audited contained documented reports of treatment for diabetes during hospitalisation.

Cases assigned to AN-DRGs without CCs received diabetes-related interventions that included ward monitoring and laboratory biochemistry for blood glucose level, insulin and dextrose infusions, sliding scale insulin for the stabilisation of blood glucose levels, and the management of diabetic complications. Referral to diabetes educators, dietitians and specialist physicians for diabetes-related consultations were also common. Under a DRG-based payment system, the hospitals would not have received funding for the diabetes component of care for the majority of these patients.

The DRG assignment logic for diabetes is at odds with worldwide opinion about the significance of the disorder as a cause of death and morbidity. In Australia, diabetes has been identified as one of the five most common causes of death and is a common cause of blindness, kidney failure, and accelerated atherosclerotic vascular disease, causing heart attacks, stroke, and gangrene of the legs and feet (Diabetes Australia 1988; McCarty et al. 1996).

The limitations of the principal diagnosis for predicting resources used to manage some categories of patients has been recognised (Eagar 1995), particularly in those patients admitted as a result of the interaction of several conditions (Connell et al. 1984; Roberts et al. 1985). Leslie et al. (1992) found that hospital discharge summaries under-reported diabetes-related admissions by 100% and underestimated bed occupancy by over 200%. In the study reported here, inadequate clinical documentation and failure of coders to associate the principal diagnosis with the underlying diabetes resulted in some episodes of care being assigned to an incorrect AN-DRG. This situation is significant from both funding and epidemiological perspectives, particularly when the admission is primarily for treatment of a diabetes-related complication, such as leg ulcers resulting from peripheral vascular disease.

Diabetes complications affect all body systems and patients usually have more than one complication in varying stages of progression. These patients are generally more resource intensive because, in addition to the condition that resulted in admission, management for the other diabetes complications will also be required. In the study report here 358/386 (92%) of subjects had at least one secondary diagnosis related to diabetes with many having more than one. The requirement to identify one, and only one reason for admission, the inability for AN-DRGs to include some form of severity of disease index, and the lack of sensitivity towards secondary diagnosis, means that AN-DRGs are disease orientated, rather than being sensitive to variations in patient characteristics. As a result, patients with disorders such as diabetes are unlikely to be accommodated within that classification except where the admission is for an acute and unrelated reason, such as normal delivery of a baby.

The significance of this situation was demonstrated in the small sample of records where diabetes was not identified on the data base, although these people were known to the Diabetes Education and Information Unit at the Wollongong Hospital. While it is not possible to extrapolate from this small sample, these records generally represented complex episodes of care with multiple comorbidities. However due to the limitations of the discharge data base, only 10 secondary diagnosis are listed and the remainder 'drop off' the data set. Of the 22 records in this group, six had more that 10 CCs coded and two had 28. All of the admissions in this group received care for multiple secondary diagnosis and in cases of that nature, the totality of resources used to treat the patient could reasonably be expected to be significantly above the resources used to treat a patient with one secondary diagnosis. While clinicians are aware of the resources used to treat secondary diagnoses, AN-DRG assignment recognises only the most significant secondary for allocation purposes.

These findings demonstrate the inability of the DRG system to capture data describing secondary diagnosis and the implications of that for funding, research and morbidity and mortality data. In this study the records most at odds with the reabstracted data concerned episodes of care where diabetic complications clearly contributed to both the decision to admit and the resources used. The discordance was found to result from several factors, often in combination, namely the accuracy of the clinical data, the accuracy of the coding, and the inability of the DRG classification to bundle a disorder and the resulting comorbidities into a logical class based upon actual resources used.

Underestimation of resource utilisation caused by coding errors or weaknesses in the ICD-9 codes, the DRG logic or coding guidelines, will have increasing significance for health care services as DRG based-funding is incorporated into the allocation formulas of State health authorities around Australia. There is a need to investigate alternate casemix classifications such as the refined DRGs (Hindle et al. 1990), and classifications for non-acute care (Roberts et al. 1993) which have the capacity to accommodate episodes of care involving multiple secondary diagnosis.

The inherent weakness in DRG logic regarding multiple secondary diagnoses, is also evident in episodes of care where the principal diagnosis is a diabetic complication. As reported by Leslie et al. (1992), clinicians rarely associate the primary diabetes with the manifestations of that condition. Heart disease and stroke occur two to three times more frequently in people with diabetes, and account for 75% of diabetic deaths in the United States (American Diabetes Association 1993). Nephropathy is also 17 times more common in people with diabetes and 50% of people with diabetes will have neuropathy after 25 years from disease onset (McCarty et al. 1996). Iezzoni et al. (1992) have also discussed the ability of the secondary diagnoses to influence the cost of care, and have cautioned against the current assignment logic which virtually ignores the impact of secondary diagnoses.

In many of the records reviewed for the study reported here, a complication of diabetes was documented as the principal diagnosis, however the primary diabetes and the complication were usually not linked by the documentation, and/or the resulting coding. Three hundred and fifty eight records had a secondary diagnosis that is clinically associated with diabetes. However in only 30/386 (8%) of the records, a diabetes related manifestation was documented and/or coded to reflect the association. Diabetic renal manifestations, foot ulcers, gangrene, polyneuropathy, cellulitis and hyperglycaemia are examples of diagnoses, consistent with the clinical picture of diabetes. However, in this study these conditions were not identified, or not coded as diabetes related in the records that were reviewed. The high prevalence of complications amongst people with diabetes in general would suggest a link between these diagnoses and diabetes in this series of patients.

When the principal diagnosis for all inpatients with diabetes were reviewed, acute myocardial infarction, heart failure and cerebrovascular disorders accounted for 352/2185 (16%) admissions. Renal disorders, which are also commonly associated with diabetes, accounted for 65/2185 (3%) admissions. However the association was rarely evident in the clinical documentation, and therefore the coding.

The inability of AN-DRGs to account for resources between different health settings is also a weakness that has particular significance for funding purposes. Many patients with chronic disorders require ongoing care in the community. The increasing trend towards short LOS means that costs previously incurred during the hospital stay, are now passed onto other healthcare providers. In this study, 15% of patients were referred to community nurses, and 20% of patients were referred to a diabetes educator for post discharge care. However, these resources, which may reduce the LOS and be an ongoing requirement to prevent readmission, are not taken into account as part of the cost of the episode of care.

The inability of the AN-DRG classification to link a procedure to the underlying medical condition, as previously reported by Gardner (1984), was also found to be the case in this study. Of the 150 patients who had a procedure performed, 13 were for diabetes-related conditions. However, with the exception of one patient, all were assigned to a DRG in an MDC other than MDC 10 (endocrine). The procedures, including vascular surgery and amputation for peripheral vascular disease where diabetes was the principal diagnosis, were assigned to DRGs 233, 234, 240 and 254 in MDC 5. Assignment would logically have been to DRG 520, amputation of lower limb, in MDC 10.

Anomalies such as this require further investigation in the context of the ongoing review of the AN-DRG classification. In the cases described above, assignment was directed by the ICD-9-CM code 2507, diabetes with peripheral circulatory disorders. Modifications to AN-DRG version 3 have been undertaken to correct inappropriate DRG assignment for the surgical management of peripheral vascular disease, however, at this time no research has been undertaken to investigate the impact of the changes upon data. The one procedure that was assigned to DRG 520, amputation of lower limb for endocrine, nutritional and metabolic disorders, had been assigned a principal diagnosis of 2503, diabetes with other coma. The assignment of these episodes of care is, at best, less than optimal. It is generally illogical, especially for epidemiological research.

The fundamental cause for the insensitivity of AN-DRGs to manifestations and secondary diagnosis may be explained by the history of the classification. Diagnosis Related Groups were developed to describe admissions for acute conditions which, by their nature, are not associated with ongoing and long term care. In those records where diabetes was either the principal diagnosis, or where the admission was for an acute episode of care unrelated to diabetes, for example accident or surgery, the coding and the clinical care generally concurred. However as Gonnella et al. (1984) concludes, the ICD-9 codes are designed to classify episodes of care rather than patients, and while that may be appropriate for 'one off' admissions, the DRG logic and coding rules do not accurately capture the complete episode of care for complex cases with multiple diagnosis.

Consider a simple example involving two patients. The first has a principal diagnosis of diabetes with neurological manifestations (ICD-9-CM code 2506), and the second is a diabetic with a principal diagnosis of mononeuritis of lower limb unspecified (code 3558), mononeuritis of unspecified site (code 355.9), polyneuropathy other (code 357.8) or polyneuropathy unspecified (code 357.9). The interventions for these two patients would be clinically similar and involve similar costs. However, they would be assigned to different DRGs because the coding system focuses upon the disease rather than the patient. Accurate and detailed clinical data is essential and, without that clarity of information from the clinician, the ICD-9-CM Tabular List is of little use to the coder.

The question is whether the single reason for admission is the diabetes, or the comorbidity, or the combination of both, and the answer can only be provided by clinicians. However, as this study has shown, the association is seldom made. For the purposes of DRG assignment a decision regarding the single reason for admission must be made, however for funding and planning purposes, information about the current health status and stage of disease may be more useful to describe the resources required to manage patients with chronic disorders.

If health planners and clinicians are to use DRG data to predict the mortality and morbity associated with chronic disorders, then the current classification needs modification to ensure that patients are grouped according to both the principal diagnosis and the progression of the disorder. The latter may sometimes (but not always) be indicated by secondary diagnoses.

8.2.2 Data quality

Perhaps the single factor that most impacts upon coding decisions is the quality of the clinical data. Early studies have identified the common failure of physicians to list as diagnoses all those conditions that have been either treated or used hospital resources (Lloyd & Rissing 1985; Reid 1988). However the situation does not appear to be improving (Donoghue 1992; Holt & Anderson 1992; Leslie et al. 1992).

In this study, 43% of records contained a total of 332 diagnoses that were not listed, and therefore not coded, according to the care described in the records. A further 140 records contained reports of treatments for 279 secondary diagnoses that were listed but not coded. This under-reporting, which is due to omissions in both coding and documentation, could have significant effects on funding levels based exclusively on coded diagnostic and procedural data.

The usefulness of the principal diagnosis as the predictor of resource consumption has been questioned by other researchers (Gonnella et al. 1984; Connell et al. 1984). The propensity of the clinical documentation, and coding errors, to compromise the abiliy of the principal diagnosis to reflect the care that was received has also been demonstrated (Roberts et al. 1985; Donoghue 1992). In this study, the principal diagnosis, which is the basis for

DRG assignment, reflected the care that was given in 85% of audits. However the coded secondary diagnoses reflected care in only 65% audits. In only 58% of audits were all diagnoses listed according to the care given. These results reflect the findings of other researchers, and therefore consideration need to be given to how the AN-DRG logic can be revised to accurately reflect both the principal reason for admission and concominant conditions.

The possibility for optimising coding to benefit reimbursement to the hospital (Simborg 1981) was not demonstrated in these results. In fact, coding disadvantaged the hospitals by underestimating resources. Resources such as the Diabetes Education Service (which has a full time staff of eight and an annual budget of $400,000) and the Nutrition Department were not reflected in the coding although the majority of patients received these services.

Provision does exist to code these services by using V codes such as V65.3 (dietary surveillance and counselling) and V65.4 (other counselling not elsewhere classified). V codes are assigned to describe factors that influence health status and contact with health services.

Visits by a specialist physician for a diabetes-related consultation were also not recorded. In the Illawarra, physicians have the status of Visiting Medical Officers to the hospitals and as such are employed on a sessional rate or staff specialist modified fee for service. Data regarding the volume and nature of services provided by physicians could be used for future planning, such as decisions about employment of staff specialists or review of the current sessional arrangements.

Failure of the discharging doctor to record whether the diabetes was considered to be controlled or uncontrolled was also a common omission. It is current coding policy to code all diabetes admissions as controlled unless the clinician documents that the patient has uncontrolled diabetes. As a result, 85% of records were coded as 'controlled' although 53% of patients received interventions that are consistent with unstable blood glucose levels for example, dextrose and insulin intravenous infusions and sliding scale insulin. With a high proportion of patients coded as controlled, one would expect that diabetes would have very little impact upon the treatment and hence resource consumption. However, as demonstrated by the chart audits, and supported by the analysis of variance, that is not the case.

This anomaly further demonstrates the inability of the AN-DRG classification to accurately reflect the resources used to treat diabetes. Whether that is due to the classification logic, or the coding and clinical documentation, or a combination of these factors, cannot be determined from this study. However, given the increasing use of casemix-based funding, research seeking that information needs to be undertaken and the results considered in the development of future casemix classifications.

Failure of clinicians to correctly document whether the patient had Insulin Dependent Diabetes Mellitus (IDDM) or Non-Insulin Dependent Diabetes Mellitus (NIDDM) (see Definition of Terms), was also a common documentation error in this study which resulted in allocation of an incorrect ICD-9-CM code. Clinicians often documented NIDDM as IDDM, based upon insulin as part of the management regimen, and it was not unusual for patients to be classified as NIDDM in one admission and IDDM in another. Some patients were identified as both IDDM and NIDDM in a single admission.

Whether a patient is coded as NIDDM or IDDM is significant given the current coding guidelines, and also for epidemiological reasons. It is policy to code all people with NIDDM who are receiving insulin as uncontrolled (National Coding Centre 1995a). However in practice 30% of people with NIDDM are prescribed insulin to assist them to achieve better control. The fact that they are prescribed insulin, particularly if insulin is used prior to admission, does not necessarily indicate that the diabetes is uncontrolled, and in fact the use of insulin may ensure that the blood glucose level remains within the range that is clinical acceptable.

Clinician's failure to properly identify IDDM and NIDDM has also been reported in other studies (Leslie et al. 1992), as has incorrect coding of diabetes related conditions (Connell et al. 1984; Williams 1985; Leslie et al. 1992). In this study the documented principal diagnosis was changed following research on 91 records of which 23 were diabetes related. One hundred and twenty two codes for the secondary diagnosis were also found to be incorrect.

While the onus is upon the coder to consult clinicians concerning discrepancies in the documentation, practical difficulties militate against that course of action. Coding deadlines, lack of immediate access to clinicians, response delays, and the coders choice to accept without question the clinician's stated diagnosis are reasons for coding errors.

The term coding compromise has been used to describe this situation (Griffiths, Hindle & Barnett 1995). Coding compromise is described as:

> '...the situation that exists when, after study, the coder continues to be uncertain about the principal diagnosis therefore coding decisions are based upon the coder's understanding of the clinicians interpretation of the data at that particular point in time'.

This is a serious situation for clinicians, coders, and hospitals. The accuracy of the resulting data would be questionable with implications for the quality of the casemix and the accuracy of DRG assignment and epidemiological data. These types of errors are also significant for DRG-based funding. The literature is replete with studies from Australia and overseas that demonstrate similar problems with clinical documentation and coding (Lloyd & Rissing 1985; Reid, 1988; Reid, 1991; Donoghue, 1992; Holt & Anderson 1992). The cost of coding errors for a group of Australian hospitals has been recently estimated (Donoghue 1992).

The study reported in this thesis was not designed to focus on coding errors or their potential cost for hospitals. The aim of this research was to assess the ability of AN-DRGs to classify episodes of care where diabetes was documented, into groups that were clinically homogenous and iso-resource. It is fair to say that the re-abstraction of medical records for this study was not undertaken within the constraints faced by coders. The New South Wales Teaching Hospital Industry Standard of 11 records per hour (Donoghue 1992), places considerable pressure on coders to act decisively and quickly. Coders require a high level of knowledge regarding management practices and protocols, and some understanding of pathophysiology in order to make accurate decisions regarding allocation of principal and secondary diagnoses. This is particularly important in complex episodes of care.

The following two discharge records from the study demonstrate the dilemmas for coders, and the potential for both DRG creep and coding compromise. Although the they share similar clinical characteristics, the DRG allocation (and therefore funding) and the epidemiological data describe two different patients.

Record 1	DRG: Cost weight LOS Principal diagnosis: Secondary diagnosis	529 1.2500 7.86 25000 585	(diabetes, age > 35) diabetes mellitus without complications type II chronic renal failure
Record 2	DRG: Cost weight LOS Principal diagnosis Secondary diagnosis	578 2.1800 9.08 25042 58381 585	(other kidney / urinary tract diagnosis age> 9) diabetes mellitus with renal manifestations Type 11 or unspecified type, uncontrolled nephritis and nephropathy in diseases classified elsewhere chronic renal failure

Inaccuracies in the procedure codes were also found in this study, with 27 being changed during the reabstraction. Inaccuracies in the coding of surgical procedures associated with the management of diabetes have been shown to be as high as 87% in one study (Leslie et al. 1992).

8.3 *Potentially useful ideas in other classifications*

One reason why AN-DRGs perform relatively poorly when classifying diabetes is that the classification is unable to accommodate heterogeneity between patients with the same disorder. However, in diabetes and other chronic disorders, the nature of the condition means that patients will not follow a predetermined clinical course. The elements of a casemix classification that could go some way towards achieving a standard of homogeneity, that demonstrates both statistically and clinically acceptable, are emerging. In this section a range of alternative casemix models are discussed.

One desirable feature of the Refined Diagnosis Related Groups (RDRG) variant is that it makes more use of data on secondary diagnoses (Hindle et al. 1990). This is significant, because the inability of DRGs to accommodate secondary diagnoses has been identified as one cause for high variations in resource use within some classes. In the study reported here, the low RIV demonstrates a low level of homogeneity within the classes based on LOS. Episodes of care assigned according to the RDRG system, are separated to one of three levels for medical cases and four levels for surgical cases according to imputed variations in the intensity of resources used during the episode of care: it has been found that LOS (and hence cost) is highest at level 0 and declines through the other levels.

The Canadian variant of DRGs, Case Mix Groups (or CMGs) takes a conceptually different approach which involves making a formal distinction between the comorbidity and the complication. The distinction is made through the clinical documentation and subsequent coding of the discharge summary (Hindle 1992; Pilla & Hindle 1994).

In brief, each diagnosis is required to be coded to reflect its contribution to the admission. The levels are known as diagnosis typing and require a diagnosis to be coded as either most responsible, primary complication (a comorbidity requiring treatment during the episode), or secondary complication (a condition which did not contribution to the decision to admit of add to the length of stay).

In some instances a single treatment is related to two or more diagnoses affecting different body systems, while conditions which demand similar care might be coded differently to reflect cross-system effects. In some cases, including diabetes, a CMG may appear in two or more MDCs (Hindle 1992; Pilla & Hindle 1994). The ability to code across the classification would improve the data from a research perspective, in addition to improvements in the measurement of effects on costs.

Some casemix classifications, such as Ambulatory Casemix Groups, are designed to cover care requirements over prolonged periods of time and/or across settings. This bundling (or aggregation) of services has been suggested as an appropriate means to organise the products of care for psychiatry, AIDS/HIV, and diabetes (Hindle 1995). Hospitals would be paid a single payment to cover care which may include inpatient and outpatient services. The advantage for insurers is that continuity of care is a reality and incentives to shift costs are reduced (Hindle 1995). The management of diabetes requires a combination of inpatient and outpatient services, over the life of the individual. The ability to bundle services for a predetermined time frame, and across settings, would provide evidence to support service planning, in addition to data to inform research and reimbursement.

In this study, tests of statistical homogeneity, and assessment of clinical homogeneity by chart audits, demonstrated that the AN-DRG classification ignores conditions that consume significant quantities of resources. Casemix designs that reflect the quantum of resources used to manage secondary diagnoses, in addition to the principal diagngosis, have been developed and are discussed below.

The Computerised Severity Index (CSI) enables a level of severity to be assigned to patient records (McGuire 1991). Development of the index was based upon the notion that certain hospitals may attract patients who were 'sicker' than other patients with a similar principal diagnosis and the index would enable adjustment to the PPS to reflect increased resource intensity. The CSI is based upon the documentation of identified secondary diagnoses which, if present, direct the episode of care to a classification with a higher weighting.

Severity refinement is similar in some respects to CSI, in that assignment is based upon the identification of secondary diagnosis, however final assignment is determined following evaluation of the clinical information more extensively than is the case with CSI (McGuire 1991).

Disease Staging is a casemix grouping system that categorises a patient into one of four levels depending upon progression of the principal diagnosis. Each stage can be further divided to reflect the onset of complications and variations in the disease process (Horn et al. 1983). These authors also describe a generic severity of illness index, that assigns patients to one of four levels according to the values of several variables. The variables relate to the burden of illness for the patient, the onset and progress of complications, patient dependency and the extent of nonoperating room procedures.

Diabetes, like other chronic disorders, is progressive and almost always results in the patients developing complications that effect many organ systems. As a result, management requires a variety of ongoing hospital and community services. All of the models discussed above have advantages in some areas over the AN-DRG classification for chronic disorders. These casemix classifications exhibit the ability to take account of resources used to treat all diagnoses, rather than focusing upon resources used to treat the principal diagnosis as is the case with AN-DRGs. In addition, bundling has the ability to classify episodes of care that go across settings and extend over time. For that reason, aspects of bundling should be considered in the design of a classification system for disorders such as diabetes that require life-long surveillance.

8.4 Some ideas for refinement in diabetes classification

The AN-DRG classification focuses on the episode of hospitalisation, rather than the characteristics of the patient. While that approach may be appropriate for acute disorders, the results of this study indicate that, the predictor variables of the AN-DRG classification are less than optimal for predicting LOS, and cost, for all categories of patients. The classifications described above do take account of some the weaknesses identified in the

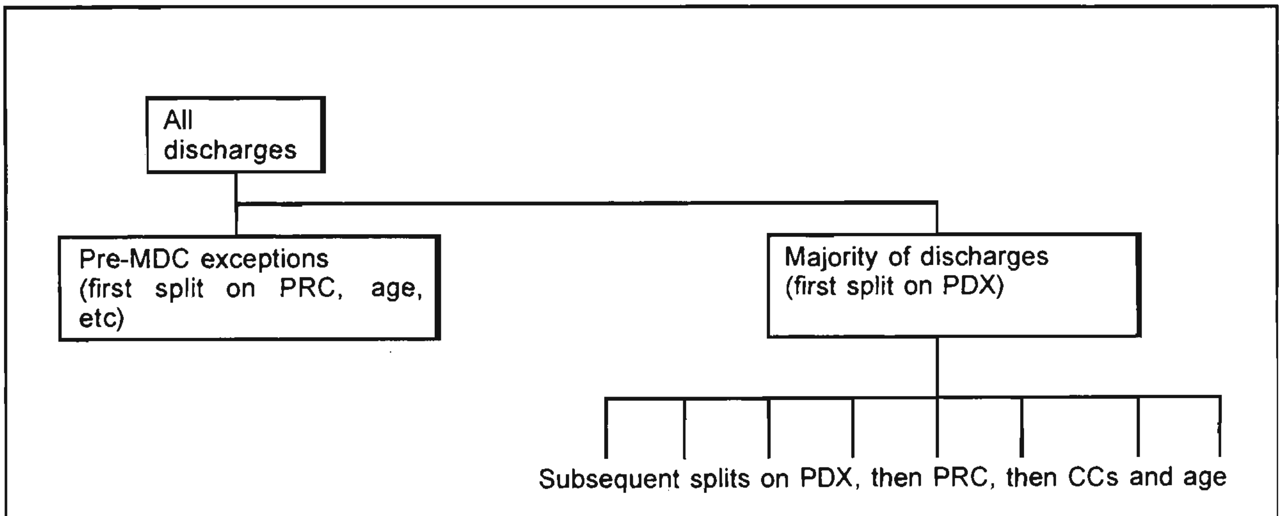
AN-DRG classification, such as severity of illness. However, they have not been incorporated into the logic of version 3, released in July 1995.

Alternative casemix models, based primarily on the secondary diagnosis, have been developed in this study and are presented in this section. It is not within the scope of this study to undertake extensive testing of theories for casemix development. Nevertheless, the conclusions that can be drawn from the literature review, and the analysis of the homogeneity of the assigned AN-DRGs, demonstrate that factors, in addition to LOS, influence the resources that are consumed by people with diabetes. As shown in this study, people with diabetes have multiple disorders, therefore differentiating at the level of the secondary diagnosis is an alternative logic that warrants consideration.

One of the requirements of the AN-DRG classification, is that all of the information required to assign a case to a final class, must be routinely collected in hospitals. A category of routinely collected data, that is almost entirely ignored in the current AN-DRG assignment logic, is clinical indicators such as secondary diagnoses. With such indicators as discriminators in the assignment logic, a variety of alternative classifications could be developed to accommodate variables such as co-existing disorders, severity of disease and multiple diagnoses. A more clinically informed and sophisticated view of classification is required to take account of the progressive nature of chronic disorders. That requirement suggests, that the next stage of casemix development is to break away from a single model approach to classification of all diseases.

The current assignment logic for AN-DRGs is described in section 1.6 and demonstrated in Figure 1-2 of this thesis. For ease of comparison with the alternative models described below, Figure 8-1 summarises the current logic of AN-DRGs.

Figure 8-1 : overview of current AN-DRG logic



PDX	Principal diagnosis	PRC	procedure
MDC	Major diagnostic category	CC	comorbidity or complication

With the exception of cases coded to a pre-MDC class (such as all patients with a tracheostomy), cases are split in the first instance according to the principal diagnosis or procedure. Some recongition is given to secondary diagnoses, if considered to be significant when associated with a particular principal diagnosis. Patient characteristics such as age, gender and type of discharge also influence allocation in some cases.

As discussed previously in this thesis, the current logic was designed to classify episodes of care where the principal diagnosis is the major predictor of the resources that are required to treat the patient. Although this model is currently used, it is not the best solution for cases where management of secondary diagnoses is a significant component of the cost of care.

In the models presented here as alternative casemix classifications, diabetes has been used as the example. The models may be equally applicable to other conditions such as end stage renal failure and asthma.

8.4.1 Model using diabetes staging in secondary diagnosis logic

The majority of patients in this dataset were assigned to a DRG that does not take secondary diagnoses into account. However in practical terms, patients with a concomitant disorder as a secondary diagnosis (like those with diabetes) and those with multiple secondary diagnoses are more resource intensive than patients with the principal diagnosis alone. However the AN-DRG logic effectively ignores the influences of secondary diagnoses for assignment of the majority of cases reviewed.

With a mean LOS of 8.6 days, the population in this study stayed significantly longer that the mean LOS of 4.1 days for all patients in IAHS hospitals during the study period. However, within the study population there was no difference in LOS between patients assigned to a AN-DRG with CCs and those assigned to an AN-DRG without CCs.

This finding suggests a weakness of the current CC lists to accurately reflect the clinical characteristics of patients and an inability to accurately account for their resource requirements. As previously discussed, the LOS has been identified as the independent variable to predict the cost of the majority of inpatient admissions. Therefore, it is logical to expect that cases assigned to a class with CCs would have an ALOS that exceeds that of cases assigned to those classes without CCs.

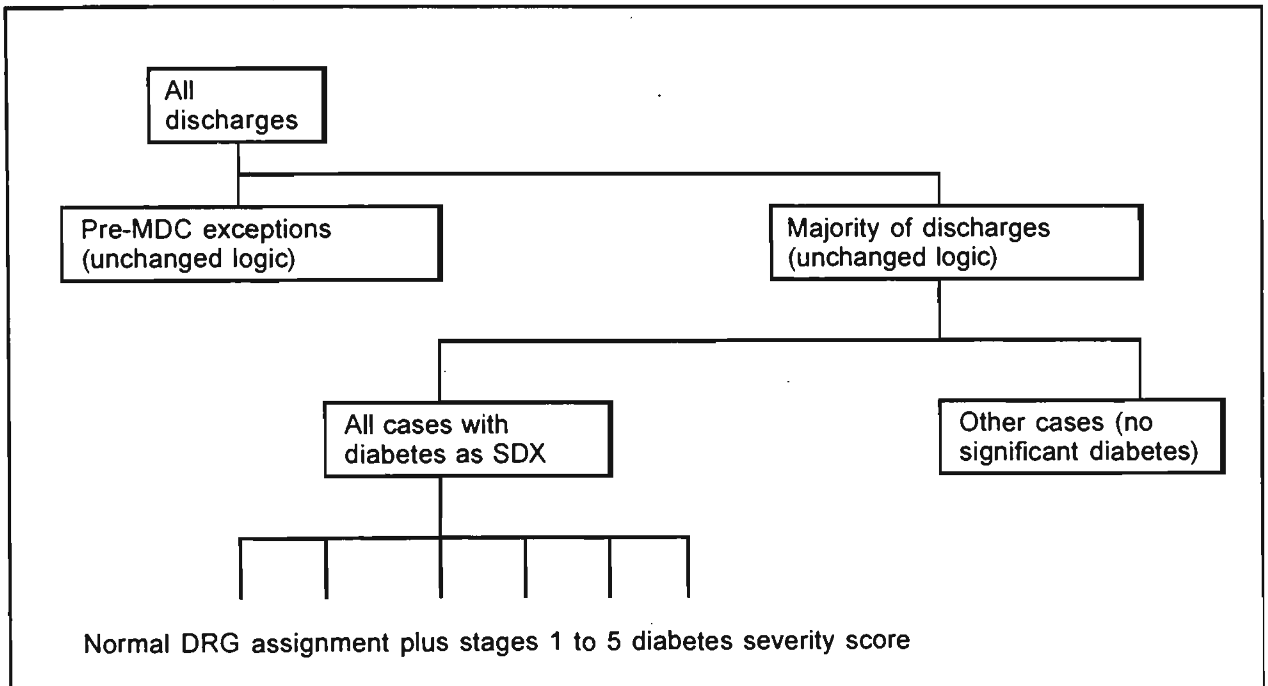
An assignment model directed by diabetes as a secondary diagnosis would not be based on the current CC lists. Rather, the initial split would identify those cases where diabetes was a secondary diagnosis as shown in Figure 8-2.

Using this model, all cases would be assigned an ICD-9-CM code according to the principal diagnosis or procedure. Those patients with diabetes as a secondary diagnosis would be assessed using a severity index that reflects the clinical progress of diabetes, and the intensity and complexity of management interventions. The model presents five stages which reflect the increasing morbidity of diabetes defined as a condition requiring attention during the hospitalisation.

Stage 1

No treatment was received for diabetes during the episode under review: assignment according to principal diagnosis.

Figure 8-2 : alternative AN-DRG logic using staging of diabetes as secondary condition



PDX	Principal diagnosis	PRC	procedure
MDC	Major diagnostic category	CC	comorbidity or complication

For stages two to five, additional cost weights will be added to the principal diagnosis to reflect the increasing severity of the diabetes.

Stage 2

Routine management interventions such as ward monitoring of blood glucose level and consultations with the diabetes educator and dietitian.

Stage 3

Management for unstable blood glucose levels. Includes diabetes related consultations with a physician, commencement on insulin and intravenous insulin.

Stage 4

Evidence of diabetic complications including kidney disease, lazer therapy to retina, management of peripheral vascular disease, documented evidence of neuropathy, stroke.

Stage 5

Treatment for multiple diabetes complications. The clinical progress of diabetes ultimately results in multiple complications. For epidemiological purposes differentiation of complications is necessary. Therefore cases identified as Stage 5 would be documented to reflect the nature of the complications and the class would be weighted to reflect the resources required to manage multi-system dysfunction.

This model assumes that the cost of care is related to the progress of the disease rather than the interventions during the current admission. For example, a patient who has developed complications will be more costly to treat than a patient who has no complications but who has unstable blood glucose levels.

This model involves several assumptions. First, as has been demonstrated in this study, the majority of cases with a diabetes related diagnosis will receive some form of management for diabetes during hospitalisation regardless of the principal diagnosis. Second, diabetes complications are progressive and effect all body systems. Therefore costs associated with managing the disorder will compound. Third, diabetes will increase the resources required to treat almost all principal diagnoses and procedures, even if diabetes does not appear to be a contributing factor. Therefore, increasing the cost weight to reflect the severity of diabetes will ensure that reimbursement reflects the cost of care. The data would also be more useful for research purposes.

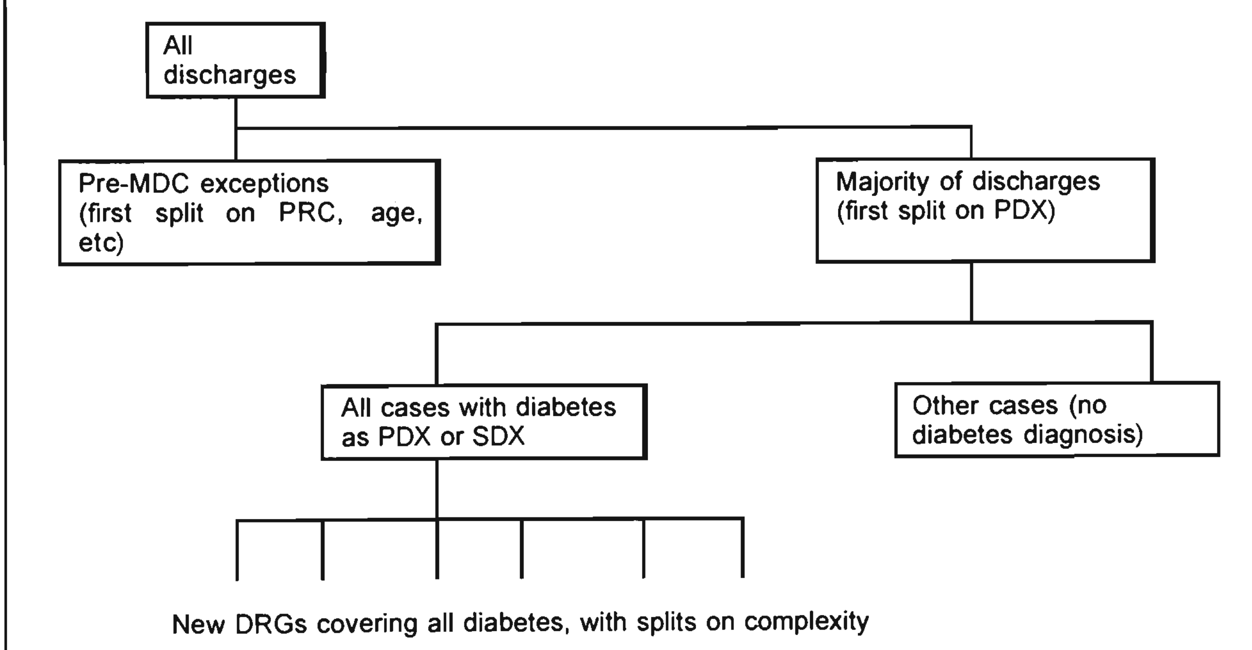
The advantage of this alternative to current AN-DRG logic, is that the inclusion of scales to measure severity, differentiates between patients with the same principal diagnosis. That information can be applied to identify those hospitals who treat 'sicker' patients, to provide data about the precise quantity and nature of resources that are consumed, and to provide a basis for equitable reimbursement to hospitals.

8.4.2 Model assigning all diabetes to one part of the assignment tree

Patients with chronic disorders typically present with multiple secondary diagnoses, resulting from the influence of the disease process upon body systems. Using diagnoses that are indicative of a single disease process as the basis for a discrete category of episodes, provides groups that have clinical meaning and use similar resources.

Figure 8-3 presents a model that groups cases into final classes based upon the presence of secondary diagnoses that are indicative of diabetic complications. The current AN-DRG logic assigns these episodes to final classes in many DRGs. Grouping the episodes into coherent classes could provide better data both for funding and for health planning purposes.

Figure 8-3: alternative AN-DRG logic using presence of complications of diabetes



PDX	Principal diagnosis	PRC	procedure
MDC	Major diagnostic category	CC	comorbidity or complication

The AN-DRG version 3 DRG 520 (diabetic foot) provides a model that could be generally applied to episodes of care where a chronic disorder is identified as a diagnosis. The logic that directs cases to AN-DRG 520, is based upon the coding of diagnoses that are indicative of peripheral vascular and neurological complications of diabetes. Cases assigned to this class have diabetes in addition to at least two conditions, drawn from predetermined lists, which include codes for peripheral vascular disease, peripheral neuropathy, infection and/or ulcer, and deformities and/or amputations (National Coding Centre 1995c). The assignment rule is applied regardless of which condition is identified to be the principal diagnosis.

This model could be adapted for other diabetic cases. An admission where both a diabetes specific code and/or one of the codes for conditions associated with the complications of diabetes, would result in assignment to an appropriately defined and weighted DRG. The combination of assigned codes rather than the principal diagnosis directs allocation.

In practical terms, the management of patients who have diabetes and nephropathy, for example, is the same regardless of the primary cause of the nephropathy. However under current AN-DRG logic the coding could direct two clinically similar patients to different classes. A patient who has nephropathy (code 583.0) and diabetes (code 250.00) would be assigned to a different class to a clinically similar patient who had diabetes with renal manifestations (code 250.40) and nephropathy in diseases classified elsewhere (code 583.81). The first example could be assigned to AN-DRG

571 Renal failure without CC, and the second to AN-DRG 570 Renal failure with CC.

Under the proposed model, a diagnosis of either NIDDM or IDDM (codes 250.00 and 250.01 respectively), would result in assignment to an appropriately defined and weighted AN-DRG when listed in association with a diagnosis coded to one or more of the categories indicating complications of diabetes. Examples of codes associated with microvascular and peripheral vascular disease are given in Table 8-1. Other codes that would be taken into account include selected eye and renal disorders and neuropathies.

Table 8-1 : examples of codes indicating complications of diabetes

Microvascular disease:	
All codes listed under the following	
581	Nephrotic syndrome
582	Chronic glomerulonephritis
583	With lesion of proliferative glomerulonephritis
585	Chronic renal failure
585	Renal failure, unspecified
Peripheral vascular disease:	
440.20	Atherosclerosis of the extremities
440.21	Atherosclerosis of the extremities with intermittent claudication
440.22	Atherosclerosis of the extremities with rest pain
440.23	Atherosclerosis of the extremities with ulceration
440.24	Atherosclerosis of the extremities with gangrene
443.81	Peripheral angiopathy in diseases classified elsewhere

The above codes are not exhaustive and are provided to illustrate the extensiveness of diabetes related complications. Other codes for peripheral vascular disease, including amputations, infection and ulceration would also apply.

This model recognises that patients with diabetic complications are more resource intensive, however it differs from the previous model in several ways. First there is no attempt to apportion costs according to the stage of the disease as is suggested in Figure 8-2. Second this model could also be applied to cases with diabetes as either a principal or secondary diagnosis. The cost weight would reflect the principal diagnosis, if it is not diabetes, and the complications by attracting a cost weight that is sufficient to reimburse for the additional resources that are required to manage the total episode of care.

This model does not differentiate between patients with one complication and those with several. The assumption is that cases with one documented diabetic complication will also receive care for other diabetes related conditions.

8.4.3 Casemix model with first split according to major chronic condition

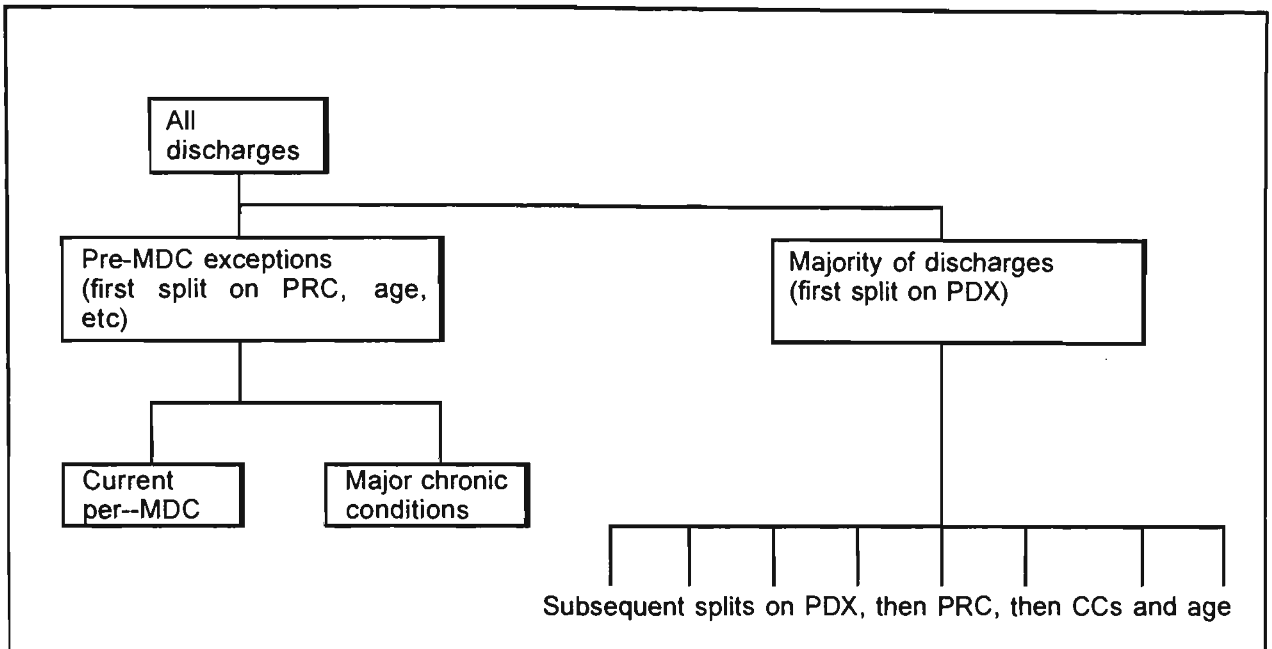
Another option would involve classifying all cases with the same chronic condition into one class regardless of the primary diagnosis, by use of the same pre-MDC logic which applies to selected case types at present (such as organ transplants and tracheostomies). This idea is illustrated in Figure 8-4.

In this model, the first split separates cases according to Pre-MDC or principal diagnosis. Those cases assigned to Pre-MDC are then split into two groups; Pre-MDC classes and classes for major chronic conditions. All other cases are split by principal diagnosis according to the current AN-DRG logic.

This model assumes that the level of resource consumption is determined by the presence of a chronic disorder regardless of the principal diagnosis, or the severity of the disorder. This model differs from the classifications described above, in that the cases are assigned to a final class at the first split and thereby do not take the principal diagnosis or principal surgical procedure into account. This model is consistent with the assumption applied to the Pre-MDC exceptions, that a particular disorder determines resource use rather that the principal diagnosis.

Cases assigned to the same class according to this model are considered to cost the same, unlike the model described in Figure 8-2 which takes severity of disease into account. Development of cost weights for this model would reflect the average cost of treating all cases with a diabetes diagnosis.

Figure 8-4: alternative AN-DRG logic, major chronic conditions as pre-MDC cases



PDX	Principal diagnosis	PRC	procedure
MDC	Major diagnostic category	CC	comorbidity or complication

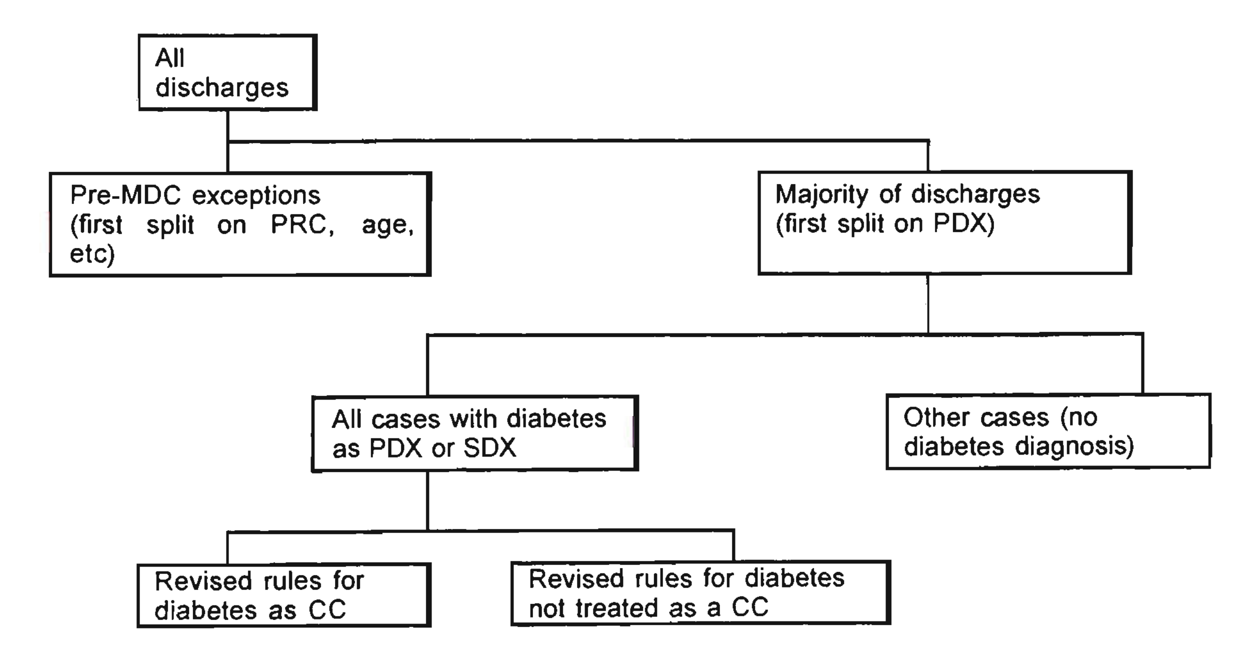
Because this model does not differentiate according to the severity of the disorder, the cost weights applied to the classes would need to be sufficient to cover the cost of resource intensive cases. Without that consideration, hospitals treating the more complex cases may be disadvantaged. Cases with a diabetes diagnosis would be clearly identified for research and service planning purposes. However, the principal diagnosis, if not diabetes, may not be easily identified in the data.

8.4.4 Casemix model with revised secondary diagnosis rules

This study found that diabetes has little influence upon AN-DRG assignment apart from cases where diabetes was the principal diagnosis. The model suggested in Figure 8-5 requires a reorganisation of the current global CC rules and lists, and their replacement with CC rules and lists specific to identified conditions.

In practice, clusters of principal diagnoses with similar CCs may share CC lists. For a case with diabetes as a secondary diagnosis, the first split is to identify Pre-MDC exceptions and the second split is to identify principal diagnosis. This is consistent with current AN-DRG logic assignment. Cases are next split into those with a diabetes diagnosis and those without. Cases with a diabetes diagnosis are further split into two groups according to the presence of a CC considered to be significant for diabetes. This model requires the CC rules and lists to be revised to include all of the codes associated with diabetes complications as described in part in Figure 8-3.

Figure 8-5 : alternative AN-DRG logic which uses revised secondary diagnosis rules



PDX	Principal diagnosis	PRC	procedure
MDC	Major diagnostic category	CC	comorbidity or complication

Assignment is based upon the principal diagnosis, as is the case with current AN-DRG logic. However, this model differs from the current logic, and the models described above, at the level of the CC lists and rules. Cases with certain secondary diagnoses will not be assigned according to established CC rules and lists. Rather assignment will be considered against CC rules and lists unique to that condition, or group of similar conditions. By recognising cases with CCs and those without, this model takes into account variations in severity of diabetes.

Any one of these models would be an improvement upon the current AN-DRG logic for assigning episodes of care with multiple secondary diagnoses, particularly if a chronic disorder was listed. Each one of these models recognises that secondary diagnoses significantly impact upon the resources used to treat some categories of patients.

The model described in Figure 8-4 most closely resembles current AN-DRG logic, the major difference being that CC lists would be specific for identified principal diagnosis. Because of the similarity between the two models, this alternative could be implemented using the systems that currently support the AN-DRG classification.

Even relatively minor amendments to the current system entail significant resources, in the form of financial support and expertise. For that reason alone, this model is the model of choice for implementation as a medium term strategy. If the opportunity arose to make extensive modifications to the classification and supporting system, the challenge would be to create the 'optimal' model; one that would be demonstrated to be clinically coherent and iso-resource.

8.5 *Other issues relating to the DRG classification*

The discussion about the AN-DRG classification cannot be confined to clinical factors alone. While a logical argument about the weaknesses in the AN-DRG system has been presented, there are political and economic factors that contribute to the debate, and these also need to be considered.

Having outlined alternative casemix models designed to reflect the total cost of care for people with diabetes, one must ask why AN-DRGs are being supported by health authorities in all Australian States. A further question that must also be asked is, if a classification that was shown to better meet the principles of the casemix model was developed, would it be adopted as a replacement for AN-DRGs?

If all hospitals could account for every diabetes treatment and complication, the cost to the Government would be $1.3 billion in 1988 terms (Diabetes Australia 1988). Of course while diabetes is the focus of this study, other chronic conditions also need to be considered. If such a classification could be developed, then it stands to reason that the reimbursement for other disorders would be similarly increased.

It could be argued that AN-DRGs have not been developed out of a desire by Government to present an equitable health system. The imperative to adopt the AN-DRG classification was firmly based in economic reasoning. As a practicle example, if the IAHS became extremely proficient in AN-DRG coding and, under PPS were entitled to double the current reimbursement, would Government double the rebate, or change the system? One probable effect would be to devalue AN-DRGs by 50%.

It could be argued that there is no incentive for every hospital to invest the resources that are necessary to ensure that all coding of medical records is 100% accurate. No Government could afford to reimburse the actual cost of care, except in the situation where treatment was rationed according to the Government's ability to pay.

8.6 Limitations of the study

Although this study makes an important contribution to the casemix debate in Australia, there are some limitations in generalising this information to the AN-DRG classification. This study investigated the ability of the AN-DRG classification to classify all episodes where diabetes is a diagnosis, into clinically coherent and iso-resource classes. While it is assumed that other chronic disorders would be similarily disadvantaged, research to verify that would be required.

Data obtained from chart audits were used to inform the research which was found not to support the hypotheses. The coder was not blinded to the original coding, nor was her recoding validated by a third party. The coding was also performed under optimal research conditions where time was not considered. This situation is unlike the reality of coding where coders are required to code up to 11 records each hour (Donoghue 1992). While this data represented one component of the data analysis, the implications of this component of the design is recognised.

8.7 Implications for research and design

What are the implications for casemix research and design? Emphasis has been given throughout this work to the need to place increased importance on secondary diagnoses in the AN-DRG assignment logic. As a result of the increasing use of a DRG-based funding models in Australia, development of a casemix model that assigns cases according to the presence of resource intensive secondary diagnoses, is a priority from the perspective of hospitals. This may ultimately be demonstrated to be an impossible gaol. If that is the case, then attention needs to focus on developing alternative casemix models for different categorise of patients. The elements of a classification that could be applied across settings, for example inpatient and outpatient episodes, also needs to be considered, and potential classifications developed. If some form of bundling is considered to be advantageous to funders and providers of services, research should begin and potential models pilot tested.

Casemix is viewed with scepticism by many practitioners and consumers of healthcare, who associate casemix funding, and DRGs in particular, with recent cuts in health budgets. As a result of efficiencies, significant reshaping of the hospital system has occurred. The political implications of casemix, and the associated advantages of the current logic for funders of services, warrants further consideration by researchers. The social implications of AN-DRG funding upon the design, and provision of health services requires are important issues for investigation. Outcomes from decisions made in 1996, will be evident within the next five to ten years.

This study demonstrates that it is unlikely that healthcare providers are being reimbursed for the complete cost of inpatient care. Ameliorating this situation will not be straightforward. If it was largely achieved, then an anticipated response would be to alter other components of DRGs, for example the cost weights, to realign reimbursement to the health budget. This point is not intended to denegrate the casemix philosophy. Rather, it is a reflection of society's expectations with respect to access to, and the nature of, health services provided by the public and private sectors.

The development and implementation of casemix models that reflect the diversity of health settings, and the complexity of humanbeings, is clearly a national priority. The proportion of Gross Domestic Product commited to health each year directs that precise measures of cost need to be developed. This study is contributing to the body of knowledge about casemix design and application.

8.8 Summary

The economic and social costs of diabetes are known (McCarty et al. 1996), however this highly significant disease is effectively being ignored in DRG-based funding, except for the minority of cases where diabetes is chosen as the principal diagnosis. As these results demonstrate, hardly any change in DRG based funding would result even if diabetes was never coded. In the light of this information, it is not surprising that the statistical analysis of the AN-DRGs assigned to the study population demonstrated a low level of homogeneity.

Based upon the results of this study it can be concluded that AN-DRGs are less than optimal for the purpose of classifying episodes of care associated with diabetes and probably, by inference, other chronic disorders, into clinically homogenous and iso-resource groups. The weaknesses in the model result from the necessity to identify a single cause for admission, when in reality a combination of disorders and events contributed to the decision to admit. Of course, one cannot ignore the fact that efficiency objectives of the classification would substantially be met if a fair price was set for each AN-DRG.

The inability of AN-DRGs to accommodate multiple secondary diagnoses and failure of the logic to link the principal diagnosis with the secondary diagnoses and procedures, prevents a true representation of resources used to manage conditions. Failure of the CC lists to adequately recognise the resources required to treat secondary diagnoses has also have been identified in previous research, and demonstrated in this study, to be limitations of the classification. The flaws in the logic are further compounded by the failure of clinicians to provide an accurate and detailed record of all diagnoses, and difficulties experienced by coders interpreting and applying the ICD-9-CM codes.

Given the origins of the DRG classification, these findings are not surprising. Originally developed to describe acute episodes of care that are completed in a single admission, it is beyond the capacity of the current classification to aggregate the cost of care for one patient across settings and over time. This situation is not only conducive to the shifting of costs between hospital and community services and between public and private sectors, but also means that some hospital services and types of patients are outside of the AN-DRG classification and as a result specific grants will be required to fund those episodes of care (Stoelwinder 1990).

The implications of these weaknesses in the AN-DRG logic for episodes of care associated with chronic conditions is becoming clear. Based upon the results presented herein, it is reasonable to expect that hospitals will not be reimbursed for the complete cost of care and that the AN-DRG data will have limited use for estimating morbidity and mortality.

CHAPTER 9

CONCLUSIONS AND RECOMMENDATIONS

IMPROVED USE OF SECONDARY DIAGNOSES

ALTERNATIVE CLASSIFICATION MODELS

PROPOSALS FOR FURTHER RESEARCH

POSTSCRIPT

Chapter 9 Conclusions and recommendations

The main aim of this thesis was to examine how the AN-DRG classification categorises episodes of care where diabetes is a diagnosis, and to assess the extent to which the resulting classes are clinically coherent and resource-use homogeneous.

The results of this research support the concerns of others with regard to the DRG logic, and its ability to group patients to achieve the desired homogeneity. In this study, the majority of admissions where diabetes was a diagnosis were assigned to classes that were neither clinically meaningful or resource-use homogeneous. It is possible that the same situation applies to other chronic disorders where patients require ongoing care, often through stages of deteriorating health.

Australian health authorities are appropriately committed to the use of improved measures of casemix as a means of quantifying the outputs of hospitals. The following recommendations are made with that goal in mind.

9.1 Improved use of secondary diagnoses

As has been shown by this research, the AN-DRG classification is less than optimal for quantifying the resources that are used during an episode of hospitalisation when diabetes is a secondary diagnosis. If AN-DRGs are to continue to be used in acute care hospitals, the classification requires revision to ensure that all of the resources that are used to manage coexisting conditions are taken into account. This could be achieved in several ways.

First, the logic that directs assignment to a final class needs to be reconsidered, and alternative models tested. One option involves assignment directed by combinations of diagnoses and clinical indicators as described in 8.4.2 above. A diagnosis, in combination with one or more predetermined diagnoses, would direct the case to an AN-DRG which has been appropriately weighted to reflect the cost of managing secondary diagnoses.

Second, the CC lists require revision to ensure that disease processes, and their complications, are identified as significant CCs and thereby influence assignment.

Third, inclusion of common chronic disorders on the list of Complicating Clinical Factors would also ensure that secondary diagnoses are recognised in the assignment process.

9.2 Alternative classification models

The fact that AN-DRGs are episode based, and not designed to be used across healthcare settings, reduces significantly their ability to accurately account for resources used to treat chronic disorders. Casemix development work, which could be applied to chronic disorders, is in progress in Australia and it is recommended that the ability of these classifications to group patients according to clinical characteristics, and resource consumption should be investigated.

To ensure complete epidemiological data and accurate reimbursement, a classification designed to fund patients over prolonged periods of time and across multiple settings rather than episodes of care could be considered.

Secondary diagnoses and complications are strongly associated with some disease processes. Management of coexisting disorders may be resource intensive, and in some instances may require more resources than are required to treat the acute condition indicated by the principal diagnosis. Alternative casemix models that take account of secondary diagnoses and complications have been proposed in Chapter 8.

9.3 Proposals for further research

Previous research has cast doubts on the ability of the principal diagnosis to predict the total resources that are required to manage a hospital admission. This situation is of particular concern for those AN-DRGs where low statistical homogeneity has been identified using LOS as the dependent variable. The extent to which the AN-DRG classification underestimates the cost of chronic disorders, needs to be assessed by completing costing studies using more than one chronic disorder. The performance of the classification when a chronic condition is either a principal or a secondary diagnosis needs to be tested.

This study has shown that the secondary diagnosis is of little significance in the AN-DRG assignment logic, even when a chronic disorder is coded as a secondary diagnosis. For those patients with chronic disorders, the secondary diagnoses may be a more accurate predictor of resource consumption. The management of the same condition differs between doctors and locations. To overcome a potential bias, a multi centre study investigating the relationship between identified chronic disorders, and resource consumption, is recommended.

This study has also identified ancillary services, for example education, to be a significant, and largely unfunded, component of diabetes management. Researchers demonstrated some time ago, that effective diabetes education and ongoing follow-up, usually commenced in hospital and continued in outpatient settings, significantly reduced hospital admissions. These services were also demonstrated to contribute to a reduced LOS when hospitalised, and delayed the onset of diabetic complications. Patient support services, such as education and counselling, are now recognised as central to the effective management of chronic disorders. However these services are largely unrecognised in coding. This situation needs to be remedied to ensure that facilities continue to take a long term view to health maintenance and disease prevention. Appropriate weightings need to be applied to the component costs of these services. Coding guidelines also need to be amended to ensure that the significance of these services is reflected in documentation and coding of discharge summaries. While the cost of nursing services are taken into account in the DRG cost weight, the extent to which those services are reflected in reimbursement for the complete episode of care is not well understood. Further research needs to be undertaken to determine the cost of providing ancillary services to treat secondary diagnoses.

9.4 Postscript

The Australian healthcare reform evolved out of a recognised need for increased efficiency and accountability within the hospital system. While the introduction of AN-DRGs into Australian hospitals has gone some way towards providing the means to measure achievement of that goal, the limitations of the classification have been recognised.

The utility of a classification that groups episodes of care was quickly recognised by providers and funders of healthcare and by researchers. However, as is the case with any product that is developed for general application, some specificity and precision is lost. Diagnosis Related Groups have been applied to quality assurance programs, as management and accounting tools, and as a basis for casemix-based funding. As a result of this diversity of applications, it has not been possible to modify and refine the classification according to a single use.

Researchers in the United States have been documenting the weaknesses in the DRG classification since the early 1980s. Australian researchers are demonstrating similar problems with the use of AN-DRGs. With the benefit of this information, one could question the implementation of AN-DRGs across all episodes of inpatient care in Australian hospitals.

Accurate DRG-data depends upon accurate clinical documentation and accurate coding. Clinicians have contributed to casemix development in Australia. Nevertheless, this study has demonstrated that imprecise and/or unclear documentation by clinicians can reduce the usefulness of AN-DRG data for funding and research purposes.

The desire to develop both a common language that describes the outputs of hospitals, and a measure against which hospitals can be compared, are important and valid goals for governments. However, there is ample evidence to suggest that a classification based upon DRGs has inherent flaws that limit its ability to perform those tasks.

Clearly, development of AN-DRGs is driven by economic imperatives. Research findings suggest that casemix-based funding models under represent the quantum of resources that are used to manage inpatients. As a result, Governments are required to reimburse hospitals for only part of the cost of care, with the balance being the responsibility of the hospital. In order to remain viable, hospitals respond to this situation with strategies such as restructuring the organisation, rationing services, shifting costs, promoting early discharge and discouraging 'expensive' patients.

Based upon this information, the effectiveness of applying the AN-DRG classification universally to all inpatient episodes of care should be reconsidered. Work is in progress in Australia to develop other casemix classifications. Ultimately it is anticipated that these may meet the requirements of a patient classification system to group inpatients who are admitted for conditions that are not managed in a single and defined episode of care.

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APPENDICES

1. CODING FOR DIABETES: CHART AUDIT FORM
2. DRGs IN THE AUDIT SUBSAMPLE
3. SECONDARY DIAGNOSES IN AUDIT SUBSAMPLE
4. STATED DIABETIC MANIFESTATIONS
5. UNCODED DIAGNOSES IN THE AUDIT SUBSAMPLE
6. DIAGNOSIS CODED AND NOT TREATED
7. PRINCIPAL DIAGNOSIS CHANGED AFTER STUDY
8. REVISED DIABETES PRINCIPAL DIAGNOSES
9. REVISED DIABETES SECONDARY DIAGNOSES
10. REVISED PROCEDURE CODES

Appendix 1 Coding of diabetes: chart audit form

A subsample of 385 records was selected from the sample of 2094 discharges with diabetes diagnoses at IAHS hospitals in 1993-94. The medical record files were then retrieved for the subsample, and data extracted in accordance with the following instrument.

1. Survey No. _________ 2. MRN ________________

3. Hospital code _______ 4. SEX M / F 5. AGE _____ (years)

6. Total days in hospital _____ (days)

7. DRG assignment _________________

8. Stated Principal diagnosis (ICD-9-CM) _______________________________

9.

(0) Type II	NIDDM	Unspec /not stated as uncontrolled	( )
(1) Type I	IDDM	not stated as uncontrolled	( )
(2) Type II	NIDDM	Unspec / uncontrolled	( )
(3) Type I	IDDM	uncontrolled	( )

10. Diabetes Code - SDX ____

____

11. Did Doctor(s) state controlled or uncontrolled diabetes Y / N

12. Did Doctor(s) state Diabetes Y / N

13. Does stated Principal Diagnosis reflect care given Y / N

14. Does stated Secondary Diagnosis reflect care given Y / N / NA

15. Were all diagnoses listed (according to care given) Y / N

Comments: ____

16. Treatment given for PDX or SDX that are not coded Y / N

Comments: ____

17. Diagnosis listed and not treated Y / N _________

Comments: ____

18. Researched Principal Diagnosis

____

19. Stated diabetic manifestations ______________________________________

20. Did diabetes affect what was done even if no treatment stated for diabetes? Y / N

____

21. Were co-morbidities stated as a manifestation of diabetes Y / N / NA

22. Was surgery / procedures performed Y / N

23. ICD-9-CM Codes ______________________________

24. Was surgery part/treatment of diabetes Y / N / NA

25. Postoperative complications documented : Y / N / NA

short term insulin	( )	delayed healing	( )
infection control	( )	wound breakdown	( )

26. Diabetes education documented (in hospital) Y / N

27. Diabetes education referral following discharge Y / N

28. Dietitian consultation during hospitalisation (diabetes) Y / N

29. Physician consultation/treatment (for diabetes) Y / N

30. Ward monitoring of blood sugar Y / N

31. Pathology undertaken Y / N

microbiology	( )	biochemistry	( )
haematology	( )	cytology	( )

Other: (X-rays etc) ______________________________

32. Referral to Community Health Y / N

33. Change of code (related to diabetes) following research Y / N

34. Principal Diagnosis ______________________________

35. Secondary Diagnoses ______________________________

____

36. Procedure(s): ______________________________

37. Comments: (e.g. hospital transfer, type change, previous admission with different diabetes code; previous admission since diagnosis with no mention of diabetes)

____

____

Appendix 2 DRGs in the audit subsample

A sample of 2094 discharges was defined, which comprised all acute discharges with diabetes diagnoses at IAHS hospitals in 1993-94. The records were then assigned to classes in AN-DRG version 1. 260 different DRGs were represented.

A subsample of 386 records was selected from the sample. The following table lists the number of records in each of the 146 AN-DRGs which were present in the subsample.

DRG	Frequency	Percentage	Cumulative frequency	Cumulative percentage
3	1	0.3	1	0.3
25	1	0.3	2	0.5
27	1	0.3	3	0.8
28	1	0.3	4	1.0
31	1	0.3	5	1.3
34	10	2.6	15	3.9
35	2	0.5	17	4.4
36	1	0.3	18	4.7
38	1	0.3	19	4.9
42	1	0.3	20	5.2
45	2	0.5	22	5.7
46	1	0.3	23	6.0
48	1	0.3	24	6.2
51	2	0.5	26	6.8
54	1	0.3	27	7.0
73	1	0.3	28	7.3
74	12	3.1	40	10.4
76	1	0.3	41	10.6
77	1	0.3	42	10.9
80	1	0.3	43	11.2
81	1	0.3	44	11.4
85	2	0.5	46	11.9
120	1	0.3	47	12.2
126	1	0.3	48	12.5
130	2	0.5	50	13.0
131	1	0.3	51	13.2
134	2	0.5	53	13.8
167	1	0.3	54	14.0

170	2	0.5	56	14.5
175	2	0.5	58	15.1
177	12	3.1	70	18.2
178	6	1.6	76	19.7
179	1	0.3	77	20.0
182	1	0.3	78	20.3
185	2	0.5	80	20.8
187	1	0.3	81	21.0
188	2	0.5	83	21.6
228	2	0.5	85	22.1
229	3	0.8	88	22.9
230	1	0.3	89	23.1
231	2	0.5	91	23.6
232	1	0.3	92	23.9
233	1	0.3	93	24.2
234	1	0.3	94	24.4
240	2	0.5	96	24.9
247	3	0.8	99	25.7
249	21	5.5	120	31.2
252	21	5.5	141	36.6
254	6	1.6	147	38.2
256	1	0.3	148	38.4
257	1	0.3	149	38.7
259	2	0.5	151	39.2
260	1	0.3	152	39.5
261	7	1.8	159	41.3
263	3	0.8	162	42.1
266	2	0.5	164	42.6
268	4	1.0	168	43.6
269	6	1.6	174	45.2
270	20	5.2	194	50.4
302	2	0.5	196	50.9
303	1	0.3	197	51.2
312	3	0.8	200	51.9
313	3	0.8	203	52.7
314	2	0.5	205	53.2
317	1	0.3	206	53.5
320	1	0.3	207	53.8
321	2	0.5	209	54.3
322	2	0.5	211	54.8
323	1	0.3	212	55.1
324	1	0.3	213	55.3
325	1	0.3	214	55.6
328	1	0.3	215	55.8

329	8	2.1	223	57.9
330	6	1.6	229	59.5
331	1	0.3	230	59.7
332	3	0.8	233	60.5
333	2	0.5	235	61.0
362	1	0.3	236	61.3
366	1	0.3	237	61.6
367	4	1.0	241	62.6
373	1	0.3	242	62.9
378	2	0.5	244	63.4
379	1	0.3	245	63.6
401	3	0.8	248	64.4
403	1	0.3	249	64.7
404	1	0.3	250	64.9
409	1	0.3	251	65.2
411	1	0.3	252	65.5
413	1	0.3	253	65.7
415	1	0.3	254	66.0
416	1	0.3	255	66.2
417	1	0.3	256	66.5
419	2	0.5	258	67.0
421	2	0.5	260	67.5
432	9	2.3	269	69.9
433	1	0.3	270	70.1
436	1	0.3	271	70.4
439	1	0.3	272	70.6
442	1	0.3	273	70.9
481	1	0.3	274	71.2
484	2	0.5	276	71.7
489	6	1.6	282	73.2
492	1	0.3	283	73.5
495	1	0.3	284	73.8
498	1	0.3	285	74.0
499	2	0.5	287	74.5
529	18	4.7	305	79.2
530	10	2.6	315	81.8
531	4	1.0	319	82.9
532	1	0.3	320	83.1
551	1	0.3	321	83.4
556	2	0.5	323	83.9
563	1	0.3	324	84.2
568	3	0.8	327	84.9
572	1	0.3	328	85.2
573	2	0.5	330	85.7

578	3	0.8	333	86.5
603	2	0.5	335	87.0
614	1	0.3	336	87.3
616	1	0.3	337	87.5
643	1	0.3	338	87.8
645	2	0.5	340	88.3
646	6	1.6	346	89.9
647	1	0.3	347	90.1
651	1	0.3	348	90.4
673	1	0.3	349	90.6
685	1	0.3	350	90.9
753	5	1.3	355	92.2
755	1	0.3	356	92.5
772	1	0.3	357	92.7
810	2	0.5	359	93.2
814	1	0.3	360	93.5
831	1	0.3	361	93.8
834	1	0.3	362	94.0
836	3	0.8	365	94.8
854	1	0.3	366	95.1
855	2	0.5	368	95.6
881	1	0.3	369	95.8
883	1	0.3	370	96.1
888	2	0.5	372	96.6
889	1	0.3	373	96.9
891	2	0.5	375	97.4
930	1	0.3	376	97.7
932	2	0.5	378	98.2
933	2	0.5	380	98.7
934	5	1.3	385	100.0
All	385			

Appendix 3 Secondary diagnoses in audit subsample

A sample of 2094 discharges was defined, which comprised all acute discharges with diabetes diagnoses at IAHS hospitals in 1993-94. A subsample of 385 records was selected from the sample. The following table lists the number of records in the subsample according to the diabetes-related secondary diagnosis.

SDX code	Frequency	Percentage	Cumulative frequency	Cumulative percentage
250	235	63.2	235	63.2
250.01	78	21.0	313	84.1
250.4	2	0.5	315	84.7
250.41	1	0.3	316	84.9
250.5	4	1.1	320	86.0
250.51	9	2.4	329	88.4
250.6	4	1.1	333	89.5
250.61	7	1.9	340	91.4
250.7	3	0.8	343	92.2
250.71	4	1.1	347	93.3
250.81	3	0.8	350	94.1
250.9	7	1.9	357	96.0
250.91	9	2.4	366	98.4
355.8	1	0.3	367	98.7
356.9	2	0.5	369	99.2
362.01	1	0.3	370	99.5
583.81	1	0.3	371	99.7
684.03	1	0.3	372	100.0

Appendix 4 Stated diabetic manifestations

A sample of 2094 discharges was defined, which comprised all acute discharges with diabetes diagnoses at IAHS hospitals in 1993-94. A subsample of 385 records was selected from the sample and subjected to detailed audit of their medical record files.

The following table lists the number of records in the subsample according to the manifestations of diabetes which had been documented in the medical records.

SDX code	Frequency	Percentage	Cumulative frequency	Cumulative percentage
250.51	1	3.3	1	3.3
250.6	1	3.3	2	6.7
250.61	1	3.3	3	10.0
337.1	1	3.3	4	13.3
355.8	2	6.7	6	20.0
356.9	1	3.3	7	23.3
357.2	3	10.0	10	33.0
362.01	6	20.0	16	53.3
365.9	2	6.7	18	60.0
366.41	2	6.7	20	66.7
443.81	1	3.3	21	70.0
443.9	2	6.7	23	76.7
583.81	3	10.0	26	86.7
585.0	2	6.7	28	93.3
785.4	2	6.7	30	100.0

Appendix 5 Uncoded diagnoses in the audit subsample

A subsample of 385 records was selected of the cases with diabetes diagnoses at IAHS hospitals in 1993-94, and subjected to detailed audit of their medical record files. The following table lists the number of records in the subsample according to the diagnosis codes which had not been recorded in the discharge summaries (and therefore not entered to the computer database) but where the condition was judged to be present after review of the medical record file, and for which there was evidence that treatment was provided.

Code	Frequency	Percentage	Cumulative frequency	Cumulative percentage
008.43	2	0.7	2	0.7
041.11	2	0.7	4	1.4
041.4	2	0.7	6	2.2
041.89	3	1.1	9	3.2
111.9	1	0.4	10	3.6
112.0	2	0.7	12	4.3
112.1	1	0.4	13	4.7
132.1	1	0.4	14	5.0
197.2	1	0.4	15	5.4
244.0	4	1.4	19	6.8
244.9	1	0.4	20	7.2
250.40	1	0.4	21	7.5
250.51	1	0.4	22	7.9
250.70	1	0.4	23	8.2
250.71	1	0.4	24	8.6
250.90	1	0.4	25	9.0
251.2	1	0.4	26	9.3
266.2	1	0.4	27	9.7
272.0	7	2.5	34	12.2
272.1	2	0.7	36	12.9
273.8	1	0.4	37	13.3
274.9	3	1.1	40	14.3
276.1	1	0.4	41	14.7
276.5	7	2.5	48	17.2
276.8	1	0.4	49	17.6
277.6	1	0.4	50	17.9
278.0	7	2.5	57	20.4
280.0	1	0.4	58	20.8
280.9	1	0.4	59	21.1

289.4	1	0.4	60	21.5
290.0	1	0.4	61	21.9
291.8	2	0.7	63	22.6
292.0	1	0.4	64	22.9
293.9	2	0.7	66	23.7
298.9	1	0.4	67	24.0
305.00	3	1.1	70	25.1
305.51	1	0.4	71	25.4
305.70	1	0.4	72	25.8
311	3	1.1	75	26.9
331.9	1	0.4	76	27.2
332.0	1	0.4	77	27.6
354.9	1	0.4	78	28.0
355.8	1	0.4	79	28.3
357.2	3	1.1	82	29.4
362.01	1	0.4	83	29.7
365.44	1	0.4	84	30.1
365.9	1	0.4	85	30.5
366.41	2	0.7	87	31.2
366.9	4	1.4	91	32.6
368.46	1	0.4	92	33.0
368.8	2	0.7	94	33.7
369.01	1	0.4	95	34.1
375.30	1	0.4	96	34.4
375.5	1	0.4	97	34.8
379.50	1	0.4	98	35.1
396.3	1	0.4	99	35.5
401.9	6	2.2	105	37.6
410.91	1	0.4	106	38.0
412	1	0.4	107	38.4
413.9	2	0.7	109	39.1
414.0	3	1.1	112	40.1
414.8	9	3.2	121	43.4
414.9	4	1.4	125	44.8
416.0	2	0.7	127	45.5
423.9	1	0.4	128	45.9
424.0	1	0.4	129	46.2
424.1	3	1.1	132	47.3
427.31	1	0.4	133	47.7
427.32	1	0.4	134	48.0
427.41	1	0.4	135	48.4
427.81	3	1.1	138	49.5
427.89	3	1.1	141	50.5
427.9	1	0.4	142	50.9

428.0	3	1.1	145	52.0
428.1	5	1.8	150	53.8
431	1	0.4	151	54.1
433.1	4	1.4	155	55.6
434.9	2	0.7	157	56.3
435.0	1	0.4	158	56.6
438	1	0.4	159	57.0
440.21	3	1.1	162	58.1
442.1	1	0.4	163	58.4
443.81	6	2.2	169	60.6
443.9	5	1.8	174	62.4
444.22	1	0.4	175	62.7
45.93	1	0.4	176	63.1
453.8	1	0.4	177	63.4
458.0	1	0.4	178	63.8
465.9	2	0.7	180	64.5
486	1	0.4	181	64.9
493.20	1	0.4	182	65.2
496	2	0.7	184	65.9
511.9	3	1.1	187	67.0
515	1	0.4	188	67.4
518.0	1	0.4	189	67.7
519.1	1	0.4	190	68.1
530.8	1	0.4	191	68.5
532.40	1	0.4	192	68.8
532.90	1	0.4	193	69.2
533.90	2	0.7	195	69.9
535.40	1	0.4	196	70.3
535.41	2	0.7	198	71.0
540.0	1	0.4	199	71.3
560.1	1	0.4	200	71.7
560.81	1	0.4	201	72.0
571.3	1	0.4	202	72.4
578.9	1	0.4	203	72.8
579.0	1	0.4	204	73.1
585	5	1.8	209	74.9
588.9	1	0.4	210	75.3
590.10	1	0.4	211	75.6
592.0	1	0.4	212	76.0
593.2	1	0.4	213	76.3
593.9	3	1.1	216	77.4
599.0	3	1.1	219	78.5
614.6	1	0.4	220	78.9
627.1	1	0.4	221	79.2

682.6	1	0.4	222	79.6
707.1	6	2.2	228	81.7
715.90	1	0.4	229	82.1
716.90	2	0.7	231	82.8
719.41	1	0.4	232	83.2
721.0	1	0.4	233	83.5
724.2	1	0.4	234	83.9
724.8	1	0.4	235	84.2
729.5	1	0.4	236	84.6
729.82	2	0.7	238	85.3
730.17	1	0.4	239	85.7
733.0	1	0.4	240	86.0
733.00	1	0.4	241	86.4
733.13	1	0.4	242	86.7
784.0	1	0.4	243	87.1
784.5	1	0.4	244	87.5
784.7	1	0.4	245	87.8
785.4	1	0.4	246	88.2
786.2	1	0.4	247	88.5
786.52	1	0.4	248	88.9
787.2	1	0.4	249	89.2
788.2	2	0.7	251	90.0
788.30	4	1.4	255	91.4
79.35	1	0.4	256	91.8
799.1	1	0.4	257	92.1
873.0	1	0.4	258	92.5
906.3	1	0.4	259	92.8
916.0	1	0.4	260	93.2
92.0	1	0.4	261	93.5
923.00	1	0.4	262	93.9
996.62	2	0.7	264	94.6
996.74	1	0.4	265	95.0
997.1	1	0.4	266	95.3
997.4	1	0.4	267	95.7
997.5	1	0.4	268	96.1
998.2	1	0.4	269	96.4
998.5	2	0.7	271	97.1
e878.2	1	0.4	272	97.5
e878.8	2	0.7	274	98.2
e927.9	1	0.4	275	98.6
e929.0	1	0.4	276	98.9
v42.0	1	0.4	277	99.3
v45.0	1	0.4	278	99.6
v45.81	1	0.4	279	100.0

Appendix 6 Diagnoses coded and not treated

A subsample was selected of 385 discharges with diabetes diagnoses at IAHS hospitals in 1993-94, and subjected to detailed audit of their medical record files.

The following table lists the number of records in the subsample according to the diagnosis codes which had been recorded in the discharge summaries (and therefore entered to the computer database) but where the condition was judged not to have been treated during the episode.

Code	Frequency	Percentage	Cumulative frequency	Cumulative percentage
41.19	1	2.0	1	2.0
41.4	1	2.0	2	3.9
251.2	1	2.0	3	5.9
272	2	3.9	5	9.8
274.9	1	2.0	6	11.8
275.4	1	2.0	7	13.7
317	1	2.0	8	15.7
401.9	2	3.9	10	19.6
403.9	1	2.0	11	21.6
403.91	1	2.0	12	23.5
412	2	3.9	14	27.5
414	2	3.9	16	31.4
420.9	1	2.0	17	33.3
427.5	1	2.0	18	35.3
433.1	1	2.0	19	37.3
434.9	1	2.0	20	39.2
440.2	1	2.0	21	41.2
443.81	1	2.0	22	43.1
443.9	1	2.0	23	45.1
447.8	2	3.9	25	49.0
492.8	1	2.0	26	51.0
493.2	1	2.0	27	52.9
496	3	5.9	30	58.8
530.2	1	2.0	31	60.8
536.8	1	2.0	32	62.7
562.11	1	2.0	33	64.7
578.1	1	2.0	34	66.7
599	1	2.0	35	68.6

715.35	1	2.0	36	70.6
715.36	1	2.0	37	72.5
715.9	1	2.0	38	74.5
721	1	2.0	39	76.5
722.4	1	2.0	40	78.4
730.17	1	2.0	41	80.4
753.1	1	2.0	42	82.4
780.6	1	2.0	43	84.3
785.1	1	2.0	44	86.3
996.01	1	2.0	45	88.2
996.61	1	2.0	46	90.2
996.62	1	2.0	47	92.2
996.74	1	2.0	48	94.1
996.79	1	2.0	49	96.1
998.6	1	2.0	50	98.0
998.8	1	2.0	51	100.0

Appendix 7 Principal diagnosis changed after study

A subsample was selected of 385 discharges with diabetes diagnoses at IAHS hospitals in 1993-94, and subjected to detailed audit of their medical record files.

The following table lists the records in the subsample according to the principal diagnosis codes which were present initially and which were subsequently corrected during the audit.

Group	Study ID number	Medical record number	Initial diagnosis	Corrected diagnosis
1	1	21684	250.91	250.90
1	11	35982	250.91	250.90
1	18	226213	250.01	250.80
1	22	22604	250.01	250.90
1	23	113906	250.00	250.90
1	26	183927	250.91	250.90
1	27	301191	250.91	250.90
1	29	385731	250.91	250.90
1	30	239416	250.01	250.90
1	35	225373	250.00	250.90
2	2	291685	250.51	250.50
2	6	34674	250.71	250.70
3	36	29527	511.9	585
3	38	24542	436	434.9
3	39	256301	366.10	366.9
3	42	336664	518.81	482.2
3	44	76893	366.10	366.9
3	64	340469	996.62	998.5
3	65	102371	493.91	493.11
3	75	192428	296.8	296.80
3	92	214876	724.5	724.2
3	99	358338	790.6	250.91
3	113	319430	780.2	427.9
3	106	198571	v63.2	411.1
3	114	2821	786.5	786.52
3	117	114737	410.91	410.11
3	118	155024	431	434.9
3	131	104263	305.00	250.90

3	132	424170	410.11	410.01
3	133	148876	996.79	997.4
3	139	223908	721.1	721.0
3	141	186076	493.21	496
3	144	162160	522.0	522.5
3	149	440695	724.02	250.01
3	150	244691	715.36	717.2
3	153	185561	562.10	578.9
3	156	214876	724.5	724.2
3	164	386907	197.0	197.2
3	166	4214	436	434.9
3	187	187857	251.2	305.00
3	192	16704	v72.3	627.1
3	194	209502	112.2	599.0
3	197	447436	648.03	684.03
3	203	443929	540.9	540.0
3	204	293653	431	434.9
3	215	16396	366.9	250.00
3	219	38946	428.0	428.1
3	224	206584	428.0	428.1
3	225	21735	458.9	458.0
3	226	228177	428.0	280.0
3	227	238945	428.0	428.1
3	236	82026	700	785.4
3	235	195224	621.0	627.1
3	241	185561	531.9	280.0
3	256	134585	427.9	276.5
3	258	50601	436	431
3	261	288043	437.9	435.9
3	264	160673	481	486
3	267	1526	496	490.21
3	270	200706	v81.2	780.2
3	278	291765	709.4	728.82
3	280	414821	428.0	428.1
3	283	6755	410.11	428.0
3	376	69031	447.1	443.9
3	396	248087	366.10	366.9
3	397	113100	366.10	366.9
3	399	7408	346.91	346.9
3	402	67202	366.10	366.9
3	403	143415	366.10	366.9
3	406	225697	366.9	366.41
3	409	76893	366.10	366.41
3	413	386549	997.4	998.5

3	414	41982	443.9	996.74
4	72	141005	296.30	345.51
4	322	302580	55839	558.9
5	284	142485	780.3	251.2
5	285	8490	682.6	998.5
5	290	256131	574.20	574.10
5	291	259436	357.4	275.4
5	298	216873	153.8	153.6
5	300	112646	276.7	997.5
5	304	398693	787.0	250.90
5	311	184414	440.0	444.22
5	314	233923	443.9	443.81
5	316	163214	427.31	427.41
5	321	219475	780.3	291.8
5	323	146393	427.89	427.81
5	329	260908	599.0	250.90
5	356	243930	715.36	715.35
5	371	131907	435.9	433.1
5	373	275577	427.13	427.3

Appendix 8 Revised diabetes principal diagnoses

A subsample was selected of 385 discharges with diabetes diagnoses at IAHS hospitals in 1993-94, and subjected to detailed audit of their medical record files.

The following table reports the number of records in the subsample according to the principal diagnosis codes which were substituted during the audit because the original data were judged to be incorrect. The table related only to principal diagnoses indicating diabetes.

Code	Frequency	Percentage	Cumulative frequency	Cumulative percentage
250.0	1	4.3	1	4.3
250.5	1	4.3	2	8.7
250.8	2	8.7	4	17.4
250.9	13	56.5	17	73.9
250.91	1	4.3	18	78.3
305	1	4.3	19	82.6
345.51	1	4.3	20	87.0
366.9	2	8.7	22	95.7
998.5	1	4.3	23	100.0

Appendix 9 Revised diabetes secondary diagnoses

A subsample of 385 discharges was selected with diabetes diagnoses at IAHS hospitals in 1993-94, and subjected to audit of their medical record files. The following table reports the number of records in the subsample according to the secondary diagnosis codes which were substituted during the audit because the original data were judged to be incorrect. Only diagnoses indicating diabetes are included.

Code	Frequency	Percentage	Cumulative frequency	Cumulative percentage
041.89	2	1.6	2	1.6
250.00	45	36.9	47	38.5
250.01	1	0.8	48	39.3
250.40	4	3.3	52	42.6
250.41	1	0.8	53	43.4
250.5	1	0.8	54	44.3
250.50	3	2.5	57	46.7
250.51	2	1.6	59	48.4
250.60	7	5.7	66	54.1
250.61	1	0.8	67	54.9
250.70	4	3.3	71	58.2
250.71	2	1.6	73	59.8
250.80	2	1.6	75	61.5
250.90	18	14.8	93	76.2
250.91	8	6.6	101	82.8
251.2	3	2.5	104	85.2
278.0	1	0.8	105	86.1
355.8	1	0.8	106	86.9
356.9	2	1.6	108	88.5
357.2	1	0.8	109	89.3
362.01	1	0.8	110	90.2
427.31	1	0.8	111	91.0
428.1	1	0.8	112	91.8
433.81	1	0.8	113	92.6
443.81	4	3.3	117	95.9
443.9	1	0.8	118	96.7
511.9	1	0.8	119	97.5
583.81	1	0.8	120	98.4
599.0	1	0.8	121	99.2
e929.39	1	0.8	122	100.0

Appendix 10 Revised procedure codes

A subsample was selected of 385 discharges with diabetes diagnoses at IAHS hospitals in 1993-94, and subjected to detailed audit of their medical record files.

The following table reports the number of records in the subsample according to the procedure codes which were substituted during the audit because the original data were judged to be incorrect.

CODE	Frequency	Percentage	Cumulative frequency	Cumulative percentage
3.91	1	4.3	1	4.3
3.92	1	4.3	2	8.7
8.89	1	4.3	3	13.0
13.19	1	4.3	4	17.4
38.08	1	4.3	5	21.7
39.31	1	4.3	6	26.1
45.13	1	4.3	7	30.4
45.23	1	4.3	8	34.8
45.25	1	4.3	9	39.1
45.42	1	4.3	10	43.5
51.1	1	4.3	11	47.8
51.87	1	4.3	12	52.2
65.91	1	4.3	13	56.5
77.69	1	4.3	14	60.9
79.35	1	4.3	15	65.2
86.22	1	4.3	16	69.6
86.28	1	4.3	17	73.9
87.21	1	4.3	18	78.3
88.48	1	4.3	19	82.6
92.14	1	4.3	20	87.0
93.53	1	4.3	21	91.3
96.35	1	4.3	22	95.7
99.61	1	4.3	23	100.0