CASEMIX – THE MISSING LINK IN SOUTH AFRICAN HEALTHCARE MANAGEMENT

An overview of Casemix groupings such as DRGs and HRGs, their use for improved clinical and administrative healthcare management, and recommendations for a way forward in South Africa

A project of the Health Informatics R&D Co-ordination Programme

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Dr John Heavens

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FOREWORD

There has been increasing interest in recent years in the application of concepts and tools such as 'Casemix', 'diagnosis related groups' and 'clinical groups' in the South African healthcare environment. However, there has been minimal progress in the actual implementation of these concepts and tools.

During 1997, as a result of a new but growing awareness in South Africa of the potential importance of Casemix as a management and billing tool, the Private Health Information Standards Committee (PHISC) requested the Medical Research Council (MRC) to convene a Clinical Grouping Workgroup. The formation of this workgroup was subsequently endorsed by the National Health Information System for South Africa (NHISSA) committee. The aim of the workgroup, which includes both private and public sector representatives, is to investigate clinical grouping concepts, principles, and issues, and to recommend the most appropriate approach for South Africa. However, due primarily to resource limitations, this workgroup has not been able to make any significant progress apart from defining guidelines and requirements for the development of clinical or Casemix groupings for South Africa. Note that the term 'Casemix grouping' is used in this report in preference to 'clinical grouping' since the former term is more widely used internationally.

The MRC established a small research project on clinical grouping in the 1998/1999 financial year, to enable MRC participation in Casemix activities in collaboration with other stakeholders in the Clinical Grouping Workgroup. Due to the limitations of the workgroup, the MRC agreed to allocate additional funds to its project to enable the MRC Health Informatics R&D Co-ordination (HIRD) programme to commission this report.

Thus, this MRC report is presented as a contribution towards informing and empowering decision makers in healthcare and related fields in South Africa about:

- What Casemix management and tools are about;
- Potential implementation issues; and
- A recommended way forward for South Africa.

Comments on the proposals contained in this document will be welcomed, and further dissemination of the report is encouraged, provided that the source is acknowledged.

Dr M. W. Makgoba
President
SA Medical Research Council

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- Mr David Bourne
- Dr Ron Chapman
- Dr Mothomang Diaho
- Ms Lyn Hanmer
- Dr John Heavens
- Dr Sedick Isaacs
- Dr Neil Söderlund

EXECUTIVE SUMMARY

The aim of this report is to inform healthcare managers and clinicians, in both public and private sectors, about Casemix grouping concepts and tools, and the potential value of Casemix management techniques in their daily work. It is hoped that South African healthcare decision makers, recognising the value of Casemix, and who really wish to empower decision making, will ensure that the first steps are begun down a Casemix path.

The goals of this report are to:

- Clarify Casemix and related principles, processes and terminology;
- Outline the role and importance of Casemix in healthcare management, both clinical and administrative;
- Discuss the implications of Casemix implementation;
- Suggest a way forward for Casemix implementation in South Africa; and
- Provide sufficient detail for informed decision making as to a way forward in South Africa.

What is Casemix?

Casemix, at its most basic, is the mix of cases presenting to a health system, i.e. the range and type of patients a hospital or health service treats. Casemix is also used as a generic term to describe scientifically developed grouping mechanisms used to categorise patient care episodes in order to facilitate effective planning and management of healthcare. In South Africa the term ‘clinical groupings’ has also been used.

The basic principles underlying the development of any such groupings are that they should be:

- Clinically meaningful.
- Resource homogeneous.
- Limited to a manageable number of groups.
- Derived from routinely collected data.

Examples of such groupings include the US DRGs (Diagnosis Related Groups) and the UK HRGs (Health Resource Groups).

Why the need for Casemix?

Healthcare management is a complex process that often seems to pose insurmountable problems. These are issues that face all countries regardless of whether they are sophisticated First World or poor Third World countries.

What healthcare managers have begun to realise is that traditional, purely financial and supply focused approaches to healthcare care management are ineffectual, and that it is essential to understand and manage the healthcare system within the context of its environment in order to address a community's healthcare needs in an efficient and effective manner.

In addition, hospitals or health systems produce vast quantities of heterogeneous data which cannot provide useful information without being reduced to a manageable number of categories.

Addressing these issues requires the linkage of clinical and financial data. Casemix groupings are mechanisms developed in various healthcare management environments to address this requirement, and therefore are essential tools for healthcare managers.

It must be stressed, however, that Casemix tools are **grouping** tools, i.e. they group data elements such as diagnoses, procedures, age, gender, discharge status, etc. They are thus wholly dependent on the availability, accuracy, completeness and timeliness of such data for successful implementation.

How is Casemix used?

The use of Casemix tools facilitates a wide variety of management activities which include:

- Activity-based, equitable budget allocation.
- Benchmarking.
- Cost management.
- Pricing and billing.
- Contract funding and performance evaluation.
- Quality management.
- Establishing community-based burden of disease.
- All of this can feed policy and planning activities.

For example, Casemix groups have become a common language in many countries for describing a hospital's or health system's activities. This gives both clinicians and managers a shared understanding of the activity contained in their workload and puts them in a much stronger position when it comes to proposing and defending equitable budgets. Furthermore, costings and/or prices based on Casemix groupings make for clearer, more effective agreements between funders and providers of healthcare.

What are the implications for Casemix implementation in SA?

The introduction of Casemix, however, requires vision, understanding, commitment, careful planning and consensus between role players as it is neither an easy, quick or inexpensive process to implement, with many issues having to be dealt with.

These issues include:

1. **Appropriate and effective data collection and coding.**
   Casemix cannot be contemplated if the required data elements are not being routinely collected. In addition, when these data elements are documented and/or coded, this must be done to high standards of consistency, accuracy, timeliness and completeness. Resolution of these problems requires a number of steps which include:
   - Agreement on the coding systems to be used and implemented.
   - Consensus on coding rules and conventions.
   - Training.
   - Audit.
   - Use of computerised coding support systems.

2. **Selection and implementation of a Casemix development approach.**
   Issues that need to be taken into consideration include:
   - Choice of a single grouping model for use nationally.
   - Licensing, pricing and ownership.
   - Resource usage data for development and modification of Casemix Groupings.

3. **Resource requirements for development and modification of a Casemix tool.**

4. **Resource and management process requirements for implementation of Casemix.**

5. **Information system requirements.**
   The prime goal of any information system should be to support management processes. With the huge investments in health information systems currently occurring in both public and private sectors in South Africa, it is essential that their design and functionality meets agreed management requirements.

6. **Implementation drivers.**
   Senior decision makers need to decide up front as to:
   - The potential value of this tool.
   - How it is to be used.
   - Whether the benefits gained will outweigh the costs of implementation.

Recommendations

The following activities are suggested as being essential for successful Casemix development in South Africa:

1. Build understanding and buy-in from senior decision makers in both private and public sectors.

2. Establish approaches and mechanisms for decision making about Casemix development and maintenance for South Africa.

It is recommended that a 2-day national Casemix workshop, involving all appropriate role players, be convened as a matter of urgency in order to obtain national consensus as to approaches and mechanisms for decision making about Casemix development and maintenance in South Africa. This will also contribute to building understanding and obtaining buy-in.

The aims of the workshop should be to establish:

- The value of Casemix as a clinical, administrative and operational healthcare management tool.
- A mechanism for deciding on a national procedure coding system.
- An approach to the establishment of an appropriate national Casemix grouping for South Africa. Recommendations for an approach are included in the report.
- Mechanisms for decision making and project guidance, e.g. the establishment of a national Casemix steering committee.
- Recommendations for the establishment of a national Casemix project team.
- Sourcing of funding for the project.

Funding for the workshop should be sought from all appropriate sources, both nationally and internationally, and could be augmented by an admission fee for day one participants.

Conclusion

Various authors have recommended the use of Casemix groupings in South Africa. To date, however, none of these recommendations have been acted upon. It is hoped that this document will stimulate South African healthcare decision makers to an awareness of the importance of Casemix and to initiate the first steps towards categorising and measuring health system outputs.

This report recommends that the requirements for this journey and the route to be taken should be addressed at a national workshop as soon as possible and that all role players should participate.

Implementation of new healthcare management processes and related information system support is challenging but not insurmountable. It is something that we need to tackle head on if we are to conquer this complex and rapidly evolving business of healthcare management.

Definitions

- **Casemix grouping or groups** – a generic term used to describe any scientifically developed grouping mechanism which is used to categorise patient care episodes and which adheres to the basic principles outlined above.
- **Casemix groupers** – computerised grouping tools which automate the assignment of a Casemix category to a patient care episode.
- **Casemix tool** – a specific set of Casemix groups, codes and descriptions, e.g. DRGs, HRGs, etc., that may or may not have been incorporated into a grouper.
- **Casemix management** - the use of Casemix tools for management purposes.

INTRODUCTION

Healthcare management is a complex process that often seems to pose insurmountable problems. This complexity is compounded by the many facets of healthcare management, e.g. clinical, operational, strategic, policy, etc. that attempt, with varying degrees of success, to meet the healthcare needs of disparate communities as well as possible within the limitations of resource availability. These are issues that face all countries regardless of whether they are sophisticated First World or poor Third World countries. As these problems continue to compound, more and more healthcare managers are going back to basic management principles to try to find innovative mechanisms from the commercial world to help them. Such principles, and especially the importance and role of output categorisation, are to be found and are best understood within the context of some simple systems theory (see Briefing Box p.14).

What healthcare managers worldwide have begun to realise is that traditional, purely financial and supply focused approaches to healthcare management are ineffectual, and that it is essential to understand and manage the healthcare system within the context of its environment in order to address a community's healthcare needs in an efficient and effective manner.

Any attempt to base healthcare provision on population need (i.e. to move from a supply focus to a demand focus) must have a mechanism for defining and categorising conditions (i.e. need for care) in terms of appropriate treatments (i.e. activity) and likely outcomes (i.e. benefits). Within this context, healthcare management can be viewed as a three-tiered process:

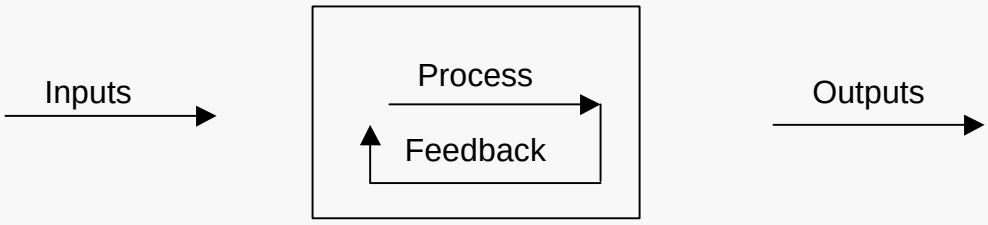
- Initially, to identify all the elements of service being supplied and to attach costs to them. This enables an understanding of how money is being spent across and within sectors and specialties. With this type of information, managers can begin to make comparisons, review efficiencies and monitor changes.
- Secondly, to identify the healthcare needs and, using the information gained on the costs of the different services, examine how the money available might be more efficiently spent to serve those needs.
- Finally, to start to address the outcomes of healthcare provision and whether the greatest benefit possible is being achieved from the resources used.[1]

This, in essence, requires the linkage of clinical data to financial data. Casemix grouping is the mechanism that healthcare management specialists have developed to address this requirement, and therefore is a fundamental tool in addressing healthcare management problems.

There can be little debate around the principle that the primary purpose of hospitals and other healthcare systems is to efficiently and effectively bring about a change in the health status of individual patients, and hence also in the communities from which they come.[2] Interest in the outputs of hospitals and health systems, can be traced back to the seminal work done by EA Codman in 1914 on concepts of

Briefing Box – Systems Theory Basics

A system can be defined as a collection of interdependent elements which interact with each other to function as a whole.



All systems have:

- A structure, i.e. one or more interdependent elements within a clearly defined boundary.
- Inputs to the system (i.e. resources). These include human, material, financial and information resources.
- Internal transformation processes which are the prime functions of the system's elements.
- Outputs or products of the system's transformation processes.
- Feedback or Control mechanisms. Most systems have a tendency to be unstable. Therefore, in order to ensure that a system remains optimised and in balance in its production of outputs (i.e. the outcome of the process is as good as possible), feedback mechanisms are essential.

Within the context of business systems, feedback mechanisms involve the generation, evaluation and appropriate response to information about resource utilisation and quality standards. At a simplistic level, these are the prime functions of modern management. Industry in general has developed effective means to manage system processes through feedback control mechanisms. Two areas of fundamental management focus that are aimed at ensuring optimal outcomes for outputs are:

- Efficiency – an economic concept which can be defined as the optimal use of inputs (especially in monetary terms) in the production of any given output, i.e. Cost Management, and,
- Effectiveness – the ability of any given process to achieve success in producing given results or to meet predetermined goals for a given output, i.e. Quality Management.

Note that assessment of efficiency and/or effectiveness must be carried out for a given, clearly identifiable output or product. Thus, in order to manage efficiency and effectiveness in healthcare, a mechanism that can categorise patient care episodes into a manageable number of clearly defined healthcare outputs is required.

hospital outputs in the USA.[3] The measurement of actual changes in health status must remain the gold standard for healthcare system product or output quantification, but current data gathering constraints globally limit an ability to meet this standard fully. However, good progress is being made internationally in moving towards this goal with the growing awareness of Casemix principles and availability of appropriate Casemix tools.

Various authors, including McIntyre, Hay, Isaacs, etc.,[4-6] have recommended the use of Casemix groupings in South Africa. To date, however, none of these recommendations have been acted upon. It is hoped that this document will stimulate South African healthcare decision makers to initiate their first steps towards categorising and measuring health system outputs.

Thus the aim of this document is to inform healthcare managers and clinicians, in both public and private sectors, about Casemix grouping concepts, processes and tools, and the potential value of Casemix for their daily work.

The goals of this document are therefore to:

1. Clarify Casemix and related principles, processes and terminology.
2. Outline the role and importance of Casemix in healthcare management, both clinical and administrative.
3. Discuss the implications of Casemix implementation.
4. Suggest a way forward for Casemix implementation in South Africa.
5. Provide sufficient detail for informed decision making as to a way forward in South Africa.

CASEMIX MANAGEMENT & TOOLS

What is Casemix?

Casemix, at its most basic, is the mix of cases presenting to a hospital or other health service, i.e. the range and type of patients a hospital or health service Treats.[7] Casemix is also used as a generic term to describe scientifically developed grouping mechanisms used to categorise hospital or health service patient care episodes (i.e. the outputs or products of these systems) in order to facilitate scientific planning and management of healthcare. In South Africa the term 'Clinical Groupings' has also been used.

The basic premises underlying the development of any such groupings are that they should be:[7]

- Clinically meaningful and coherent, i.e. the groups can be understood by clinicians, administrators, information specialists, etc., and are based on understandable clinical entities.
- Resource homogeneous, i.e. patients allocated to each group consume approximately the same amount of total resources, e.g. bed days, medicines, theatre time, nurse time, etc.
- Limited to a manageable number of groups.[8, 9]
- Derived from routinely collected data, e.g. patient demographics (age, gender, etc.), diagnoses, procedures, discharge status, etc.[9]

Examples of such groupings are the US DRGs (Diagnosis Related Groups) and the UK HRGs (Health Resource Groups).

At this point, it is appropriate to clarify some terminology which is used throughout this document:

- **Casemix grouping or groups** – a generic term used to describe any scientifically developed grouping mechanism which is used to categorise hospital or health service outputs and which adhere to the basic premises outlined above.
- **Casemix groupers** – computerised grouping tools, incorporating specific decision tree logic, codes and code categorisations, which automate the assignment of patient care episodes to a defined set of Casemix categories identified by a specific set of codes and descriptions, e.g. DRGs, HRGs, etc.[7]
- **Casemix tool** – a specific set of Casemix groups, codes and descriptions, e.g. DRGs, HRGs, etc., that may or may not have been incorporated into a grouper.
- **Casemix management** - the use of Casemix tools for management purposes.

Why the need for such groupings?

In addition, hospitals or health systems produce vast quantities of heterogeneous data which cannot provide useful information without being reduced to a manageable number of categories.

For example, patients may need treatment for one or more diagnoses. Each patient's management may require one or more procedures and/or medicines. Furthermore, different service providers may manage a health problem differently. ICD-10, a widely-used diagnosis coding system, contains more than 10 000 separate diagnoses.[7] It can be simply deduced that there must be hundreds of thousands of different combinations of diagnoses, procedures and other treatments, and thus 'types' of cases or outputs. This number of 'product lines' would be unmanageable in any commercial environment. Thus, in order to interpret the data and make it usable, particularly for management purposes, it is essential to have a mechanism or tool that can define a manageable number of clearly defined healthcare outputs. Casemix groupings, such as DRGs and HRGs, are such tools and typically contain several hundred groups.

Casemix therefore provides a fundamental tool which enables healthcare professionals and managers to begin to understand the healthcare system and to address efficiency and effectiveness issues that have for so long eluded them.

It must be stressed, however, that these are **grouping** tools, i.e. they group data elements such as diagnoses, procedures, etc. and are thus wholly dependent on the availability, accuracy, completeness and timeliness of such data.

An awareness of these issues in general and, in particular, of the need for an appropriate output definition tool has had a fundamental impact on healthcare management worldwide. Both First and Third World countries alike are investing in health information systems and tools to address these issues with the growing awareness that, without such systems and tools, healthcare is essentially unmanageable.

How are these Casemix tools used in healthcare management?

In many countries Casemix groups have become a common language for describing a hospital's or health system's activities. This gives both clinicians and managers a shared understanding of the activity contained in their workload and puts them in a much stronger position when it comes to proposing and defending equitable budgets. Furthermore, costings and/or prices based on Casemix groupings make for clearer, more effective agreements between funders and providers of healthcare.[10]

Casemix groupings were initially developed and have continued to be primarily used for the management of acute hospital inpatient stays. This makes a lot of sense as

hospital costs tend to be a major cost item in any comprehensive healthcare delivery system. Inpatients tend to be more complex cases with a significant variation in clinical management approaches, resource utilisation and outcomes. Without Casemix groupings it is extremely difficult to measure and/or predict resource utilisation and outcomes. These Casemix tools and management principles have been widely applied to the problem of hospital funding.

Two common ways that hospitals are funded, both in South Africa and abroad, are:

- Historical funding, where hospitals are simply provided with the same funding they received the previous year together with an increase related to inflation and/or as a response to a request for additional funds if appropriately motivated.
- Funding by formula. Such a formula will allocate funding to a hospital based on population served, with weightings to take into account factors which may affect resource utilisation, e.g. age, gender, socio-economic status, etc.[7]

Neither of these mechanisms directly funds hospitals for the work they actually do. Consequently, hospital clinicians and managers are not encouraged to review the work they do, or to determine how to function more efficiently and effectively.

Casemix-based funding systems can help to achieve these ends in a number of different ways. One of these is for hospitals to take a zero-based budget approach based on predicted activities. These volumes of activities and costs per activity are Casemix based. Thus hospitals can be funded on the basis of the actual work they do. This approach has been successfully used in Australia where some states introduced such a system based on the Australian National DRGs (AN-DRGs) simultaneously with significant cuts in state healthcare expenditure.[7] Casemix was seen as a tool to drive increased productivity, thus lessening the adverse impact of the cuts and, very importantly, as a mechanism for distributing funding more equitably.

Another approach was that taken in the early 1980s when the Healthcare Financing Administration (HCFA) in the USA introduced a prospective hospital payment system, based on the newly developed DRG system, for members of the federally funded Medicare programme. HCFA set a price to each DRG which was approximately equal to the average price paid historically for all patients in the DRG group. Faced with such a fixed-fee payment mechanism, hospital management, both clinical and administrative, are encouraged to examine their cost structures, resource utilisation and work practices in order to ensure that they remain financially viable. As a result they usually find that they can provide better and more efficient treatment for their patients and remain financially viable at the same time, i.e. they review and modify their services to cope with the shift of financial risk to their facility.

At this juncture, it is important to resolve one common misconception about Casemix tools, and that is that they have been developed as alternative billing systems. Casemix tools are, in fact, purely mechanisms for scientifically categorising the outputs or products of hospitals and other health systems into a manageable number of clinically defined, resource homogeneous groups.

The use of these Casemix grouping tools for management purposes has many different facets which include:

- Activity-based budget allocation, thus ensuring that available funds are distributed sensibly and equitably.
- Establishing community-based burden of disease, healthcare needs and/or trends. For example, the number of patients per Casemix group per period gives some indication of the burden of disease or healthcare needs of the population serviced by a facility or healthcare system. Changes over time can be monitored. This will facilitate decisions about what is a right balance of services to be provided and obviously leads to much better resource planning and management.
- Cost management, i.e. ensuring the most efficient and effective use of resources in a hospital or healthcare system.
- Benchmarking, i.e. by allocating patients to Casemix groups and linking these to other data elements such as number of patients, length of stay, number of investigations, treatments given, costs, etc., comparisons can be made between institutions, and between different doctors treating the same type of patients, etc. This is the process of 'benchmarking' which enables clinical and administrative decision makers to review efficiencies and effectiveness in their facilities.
- Pricing and billing, e.g. the Medicare prospective payment system outlined above.
- Contract funding and performance evaluation, e.g. use of HRGs for management of internal market contracting in the UK NHS.[2]
- Quality management, Continuous Quality Improvement (CQI) processes, outcome measurement and evaluation, and evidence-based medicine, e.g. providing doctors and nurses with comparative data on how they treat their patients and what the outcomes are (e.g. number of tests ordered for a particular DRG, length of stay, costs, etc.), thus enabling them to review and improve their practice and so to better manage healthcare.
- All of this can feed policy and planning activities at national, regional, local and/or commercial levels.[7]

Approaches to Hospital Product Definition

Since Codman's initial work on hospital products in 1914[3], there have been many experiments with different hospital product or 'output' classifications. Söderlund provides a useful categorisation of approaches, i.e.

- **Facility mix** (where hospital products are described in terms of facility capabilities),
- **Specialty or discipline mix** (where hospital products are described in terms of discipline availability),
- **Service mix** (where hospital products are described in terms of services or procedures), and
- **True Casemix** (where hospital products are described in terms of treated patients).[2]

He emphasises the need to differentiate between service mix approaches and true Casemix.

Service mix approaches define hospital outputs (or products) according to the services and/or procedures delivered to patients. This is quite a widely used approach as it is easy to implement, appeals to administrative managers and is the basis of most fee for service remuneration systems. One problem with this approach, however, is that there is an inherent perverse incentive for over servicing with concomitant excessive costs and a dropping off of quality.

This approach is widely used in South Africa and reflects the current status of the private sector hospital industry as well as some public sector hospitals. (See Briefing Box).

Briefing Box – Example of Service Mix

In a draft proposal for a Uniform Patient Fee Schedule for Private Patients attending Public Hospitals in South Africa[11], the approach taken is as follows:

- The Representative Association of Medical Schemes (RAMS, now Board of Healthcare Funders or BHF) tariffs are initially grouped into broad service groups, e.g. inpatient days, outpatient consultations, theatre procedures, imaging, laboratory, medication, etc.
- In some cases, these groups are further divided into subgroups, e.g. laboratory is divided into biochemistry, haematology, serology, microbiology and histopathology.
- The RAMS tariffs falling in these groups are then grouped into broad price categories to form the final public hospital tariffs.
- Each of these is divided, where appropriate, into a facility and a professional fee component.

This fee schedule is therefore based on groupings of services and procedures which could be provided for many different diagnostic entities, and the final groupings are not particularly resource homogeneous. Thus each inpatient care episode will be associated with multiple services or procedures, which could be described in terms of more than a single grouping. These are therefore a good example of service mix grouping. This type of grouping is very different to, and should not be confused with, true Casemix grouping.

True Casemix approaches describe hospital products in terms of groupings of whole inpatient care episodes, i.e. the products provided by hospitals are described in terms of treated patients. Thus each complete inpatient care episode is allocated to a **single** Casemix group. This is achieved by the application of an algorithm which uses routinely collected patient data such as diagnoses, procedures, age, gender, etc., to allocate each patient to a single, clinically meaningful, resource homogeneous Casemix group. [2, 12]

These Casemix groups are devised principally to meet both clinical and administrative management needs for a tool to scientifically categorise whole inpatient episodes of care, and to be able to link these groups to financial, volume and outcome data in such a way as to address issues of efficiency and effectiveness, and thus begin to establish 'best practice'.

The approaches described by Söderlund can be seen as part of a continuum of continually improving mechanisms for definition of hospital or health system outputs as a result of increasing management demands for improved tools to add value to their operational processes and decision making (see Fig. 1 below).

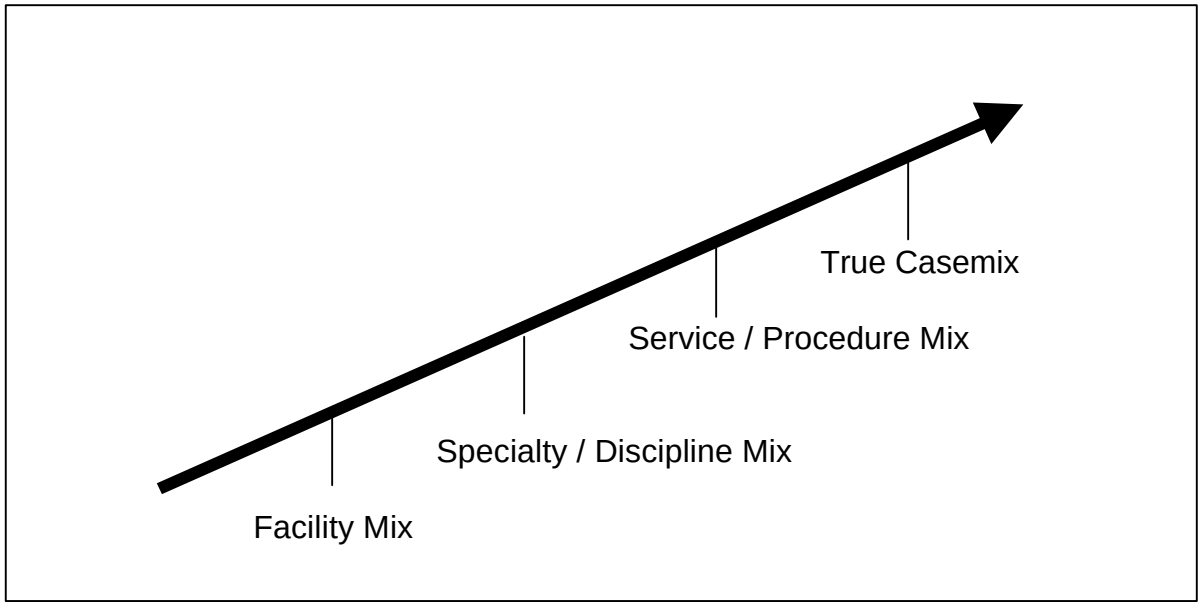


Fig. 1 - Continuum of Health Systems Output Definitions

Basic Principles of Casemix Grouping Development

(see Appendix II for details)

As previously discussed, Casemix Groupings are mechanisms by which patient care episodes are allocated to a scientifically defined set of Casemix categories identified by a specific set of codes and descriptions, e.g. DRGs, HRGs, etc. These Casemix groups are designed to meet the criteria outlined previously, i.e. they should be:

- Clinically meaningful.
- Resource homogeneous.
- Limited to a manageable number.
- Derived from routinely collected data.

DRGs (Diagnosis Related Groups) were the first Casemix groupings to be developed. Their development was started by Prof. RB Fetter and his colleagues at Yale University in the late 1960's[9] and they have subsequently achieved widespread use.[2] These initial groupings were focused on hospital outputs, i.e. inpatient care episodes. Though Casemix groupings for outpatients have been developed, the main use of Casemix worldwide remains with inpatients and therefore will be the primary focus of this document. The principles developed by the Yale team remain the principles on which most modern groupings are based and will therefore be used as an example of how such tools are designed.

DRG decision tree design

The core requirement was to design a decision tree (see Fig. 2) to categorise inpatients into a manageable number of clinically identifiable, resource homogeneous, output or product categories. Extensive use was made of both clinical expertise, to ensure clinical coherence, and statistical analysis of resource utilisation data to ensure resource homogeneity.

The data elements selected for use in DRG construction were:[9]

- Principal diagnosis code, i.e. the condition established to be chiefly responsible for the admission of the patient to a hospital.
- Secondary diagnosis code/s or CCs, i.e. Complications (conditions which did not exist prior to the admission) and/or Comorbidities (other conditions which existed prior to admission).
- Procedure code/s. All procedure codes are classified based on whether or not they required the use of an operating theatre.
- Age.
- Gender.
- Discharge status.

The first step in forming DRGs was to divide all possible principal diagnoses into mutually exclusive Major Diagnostic Categories (MDCs) based on organ systems.

Most MDCs were further divided into surgical or medical groups based on the presence or absence of an operating theatre procedure, since the presence of a surgical procedure requires different hospital resources, e.g. operating theatre, recovery room, anaesthesia, etc.

If multiple procedures were present, allocation to a single surgical DRG was based on a surgical hierarchy established within each MDC.

All medical and surgical patient groups in each MDC were also evaluated to determine if age, gender and/or discharge status consistently affected the use of hospital resources. If so, they were incorporated into the DRG structure. The DRG groups thus established were each given a code and description and these jointly make up the full set of DRG codes and descriptions.

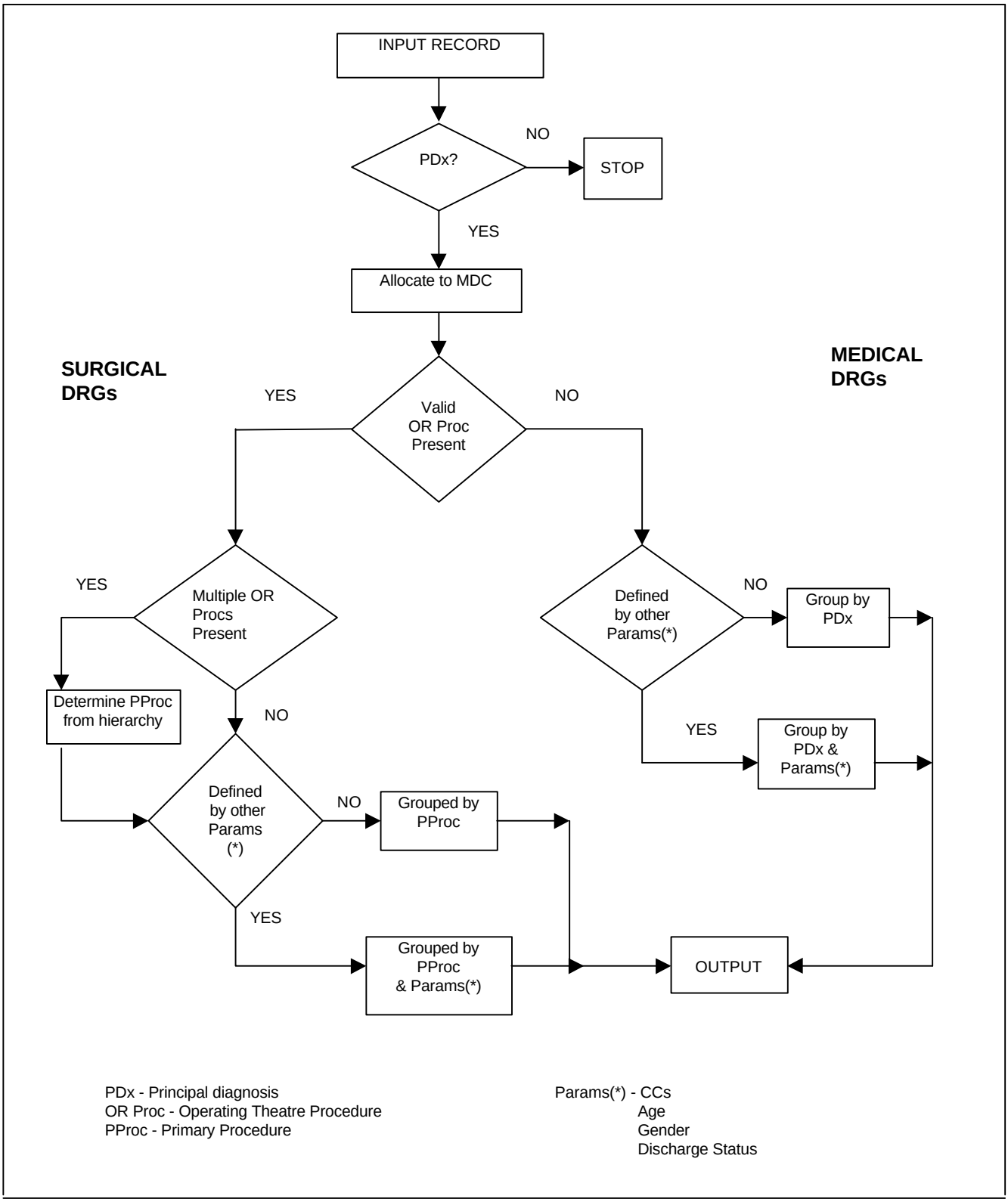


Fig. 2 - DRG Decision Tree

Length of hospital stay (LOS) was used initially as a proxy for resource utilisation in the development of DRGs.[2] DRGs have been further enhanced over time, both in the USA and elsewhere, with the collection of patient cost data for all resources used per DRG category. Exceptional cases (known as **Outliers**) are removed from the data. A simple average LOS or cost is then calculated per category. When these LOS or cost averages are divided through by the average of all categories, a relative resource **Weighting** is obtained.[13]

It must be stressed that no Casemix grouping is ever a static tool. Wherever they have been introduced they are continually revised as a result of:

- Ongoing review of categories and changing costs per category, which therefore require the recalculation of cost weights and, on occasion, changes to the categories.
- Demands from clinicians and managers for increased sophistication and coherence of the tool to better explain variations and outliers.

Casemix Groupers

It is obviously possible to allocate a patient care episode to a Casemix group manually, but this would be a time consuming process in a normal operational situation, and open to significant error. Thus Casemix groupers were developed, i.e. software was written to automate the decision tree logic and code classifications.[7] The software allocates a Casemix group to a patient automatically on entry of the appropriate patient data as outlined above. A Casemix grouper can be used in stand-alone mode, in which case the required data have to be input manually, or it can be interfaced to a larger system, fed the information automatically, and the grouper can then return the allocated group to the patient's record on the main system.

Grouping vs. coding

It is clear that Casemix groups (and their associated codes and descriptions) are always derived from the **grouping** of various diagnosis and procedure codes as well as, in some cases, a few other routinely collected data elements, i.e. age, gender and discharge status. Thus Casemix groups cannot be allocated *ab initio*, i.e. directly coded. In addition, they cannot be allocated if the required input data elements are not available.

Other US Casemix grouping approaches

DRGs were developed for the US federally funded Medicare programme for the elderly. It has been recognised that they are deficient in a number of areas if they are to be used for the general population, e.g. Paediatrics, Obstetrics, etc. Thus there was a need in the USA to develop other Casemix tools that addressed these deficiencies.

- **All Patient DRGs (AP-DRGs).** In 1987 the New York State Department of Health (NYSDH) entered into an agreement with a commercial organisation, 3M Health Information Systems, to develop a new version of the DRGs to be called All Patient DRGs (AP-DRGs). The changes incorporated into this Casemix system included:
    - New MDCs and assignment logic.
    - Other MDCs restructured.
    - New DRGs created and others restructured.
    - Major CCs used as a proxy for severity.

  AP-DRGs are used as the basis for prospective payment systems in the states of New York, Maine, Massachusetts, Washington, North Carolina and Indiana. They are also utilised by Blue Cross/Blue Shield managed healthcare plans in Massachusetts, Washington and New York.[9]

- **All Patient Refined DRGs (APR-DRGs).** These groups are proprietary to 3M Health Information Systems.[14] They are based on AP-DRGs and were designed specifically to address:
    - Severity of illness.
    - Risk of mortality.
    - Resource intensity.[9]

  The initial approach was to take AP-DRGs and create so called base APR-DRGs by recombining AP-DRGs splits, consolidating various other AP-DRGs together with some reassignment of diagnoses and procedures amongst the base DRGs.

  These base APR-DRGs are enhanced by the inclusion of four severity of illness and risk of mortality subclasses within each base DRG.[14] These four subclasses are Minor, Moderate, Major or Extreme severity of illness or risk of mortality. They are allocated according to sophisticated clinical algorithms that simultaneously evaluate multiple CCs, age, procedures and principal diagnosis.

- **Ambulatory or outpatient groupings.** The use of Casemix tools has added significant value to inpatient care and management. However, there has been relatively little work on developing groupings for outpatients and/or ambulatory or primary care patients. In addition, those that have been developed have not been widely used.[2] There are a number of possible reasons for this, including:

    - Relatively low patient costs in these settings.
    - A belief that outpatient activity and output is intrinsically more homogeneous than inpatient activity.
    - The high cost of information gathering relative to the cost of the treatment episodes being measured.

  Outpatient groupings that have been developed include:

- **Ambulatory Visit Groups (AVGs).** These were developed by the Yale group responsible for DRGs. It divides outpatient episodes by principal diagnosis into MDCs which are then further subdivided into AVGs.
- **Ambulatory Patient Groupings (APGs).** These are similar to AVGs, but grouping is initially dependent on procedure, rather than diagnosis.[2]

International Casemix approaches

The use of Casemix tools has spread worldwide. Countries have adopted one of two approaches in developing Casemix groupings appropriate to their requirements and healthcare practices, i.e.:

1. Taking a US developed grouping model and modifying the groupings according to local clinical considerations and resource analysis. These modifications usually follow one of two approaches, i.e.:
   - **Mapped Groupers.** In mapped groupers the local diagnostic and/or procedure codes are mapped to their ICD-9-CM equivalents and the results are run through the original grouper.
   - **Native Groupers.** In native groupers, the local or 'native' diagnosis and/or procedure codes are substituted for the ICD-9-CM codes in the DRG definitions.[9]
2. Using similar principles to those in the USA, but building their own decision trees and groupings *ab initio*.[8]

Australian National DRG's (AN-DRGs) are a good example of the first approach. They are based on the HCFA Medicare DRGs and have been modified over time along the lines of AP-DRGs as a native grouper, using Complicating Clinical Factors (CCFs), i.e. age, malignancy and CCs as approximations of severity to better meet Australian requirements.[15]

The UK is a good example of a country which has followed the second route. In so doing, they have progressively developed a comprehensive grouping philosophy which includes inpatient, outpatient and community Health Resource Groups (HRGs) as well as Health Benefit Groups (HBGs). (See Briefing Box).

Briefing Box – The UK Grouping Philosophy[1]

Casemix groupings in the UK commenced with the introduction of a modification of DRGs.[2] A number of problems arose, however, including:

- Poor predictive performance in some areas because of differences in diagnostic terminology and/or clinical practice between the UK and the USA.
- The lack of UK derived cost weights.

Thus the UK National Casemix Office (NCMO) was established to develop a unique set of Casemix groups and cost weights called Healthcare Resource Groups (HRGs) for the National Health Service (NHS). These were developed in the late 1980s and have undergone a number of revisions since then.[10,16]

The NCMO followed the basic premises that:

- In addition, hospitals or health systems produce vast quantities of heterogeneous data which cannot provide useful information without being reduced to a manageable number of categories.
- Any attempt to base healthcare provision on population need (i.e. to move from a supply focus to a demand focus) must have a mechanism for defining and categorising conditions (i.e. need for care) in terms of appropriate treatments (i.e. activity) and likely outcomes (i.e. benefits).

HRGs are seen as a way of categorising the treatments of patients into groups that are clinically similar and use roughly the same level of resources for acute hospital inpatient and day-case treatments. Surgical procedures are used for the allocation of patients to surgical HRGs. However, for most medical episodes of care, there is not the same simple 'driver' of activity, the equivalent of the surgical procedure, which can be used to identify resource use. Thus principal diagnoses are used as a proxy for surgical procedures in patient allocation to medical HRGs.

In order to cover the full range of healthcare treatments and activities, the NCMO has recently commenced the development of :

- Outpatient HRGs to cover activities undertaken by consultants in outpatient clinics.
- Community HRGs to cover the activities of Health Visitors, District Nursing, Midwifery, Physiotherapy, Occupational Therapy, Speech and Language Therapy and other ambulatory clinical disciplines.
- Health Benefit Groups (HBGs) which are designed to categorise the population in terms of its need for healthcare and, given appropriate care, its ability to benefit.

IMPLICATIONS FOR CASEMIX IMPLEMENTATION IN SOUTH AFRICA

The value of investing in Casemix as a clinical and administrative management tool is widely accepted.[2, 4-7, 17] The introduction of Casemix, however, does not come easily, quickly or at no cost. There are a number of issues that need to be addressed. These include:

Coding

As has been stressed before, Casemix groups (and their associated codes and descriptions) are always derived from the grouping of various diagnosis and procedure codes as well as, in some cases, a few other routinely collected data elements, i.e. age, gender and discharge status.

Casemix cannot be contemplated if these data elements are not being routinely collected, as is currently the case in most public sector hospitals and many private sector hospitals. In addition, when these data elements are documented and/or coded, this must be done to high standards of consistency, accuracy, timeliness and completeness.

Resolution of these problems requires a number of steps which include:

- **Agreement on the coding systems to be used.**
  All Casemix tools are code specific and thus there is a need to establish national coding standards before expending significant resources on developing a grouping or modifying an existing one. In South Africa there is national consensus that ICD-10 will be the diagnosis coding system in both public and private sectors. The Private Health Information Standards Committee (PHISC) has already established a Discharge Status (Disposal) Code standard which could easily be modified, if necessary, to meet grouping requirements.

  The major stumbling block is a procedure coding standard. In both the private and public sectors, the current de facto standard is the Tariff codes which are maintained by the South African Medical Association (SAMA). However, these codes have a number of shortcomings and the private sector healthcare industry took the decision that CPT-4 would be technically the best coding system to replace the Tariff codes. Implementation, however, has been bedevilled by licensing, pricing and economic impact issues and it is unlikely that CPT-4 will be generally introduced any earlier than 2001. Because of these problems, and with the international development of other more sophisticated procedure coding systems, the decision to use CPT-4 is now being challenged.

Resolution of which procedure coding standard is to be used nationally will be critical in determining a way forward for Casemix in South Africa.

- **Agreement to implement.**
  It is essential that all appropriate role players agree that, should a Casemix tool be implemented, they will ensure that processes and systems will be put in place to capture the required data elements.

- **National consensus on coding rules and conventions.**
  Clinical codes, especially diagnostic and procedure codes, usually have complex internal structures, rules, conventions, definitions and guidelines. Usage also often highlights the need for additional external rules, conventions, etc. For example, in the case of a patient admitted to hospital with multiple diagnoses - how does one decide which is the principal diagnosis and which are CCs? This decision can be complex and have significant analysis, costing and billing implications.

  Recently a PHISC Coding Network Committee was established to ensure national consensus on these rules, conventions, etc., with both private and public sector participation, to ensure consistency of approach. This committee is composed of individuals directly involved with clinical coding.

- **Training requirements.**
  Training of coders is another crucial element in ensuring high standards of consistency, accuracy, timeliness and completeness of coding. The PHISC Coding Network Committee will also look at setting up standards for training courses in such codes. In order to code accurately, experience internationally has clearly indicated that a medical background is advantageous but not necessarily required and, in itself, is inadequate without additional training.

- **Audit requirements.**
  Without continual review, international experience has shown that standards of consistency, accuracy, timeliness and completeness will gradually deteriorate over time. Thus a regular coding audit is an essential management process to ensure maintenance of coding standards.

- **Use of computerised coding support systems.**
  Most coding is currently done manually from code books. This can be greatly enhanced by the use of computerised coding systems, especially if these systems have user-friendly interfaces, include the various rules, conventions, definitions and guidelines and allow for user set-up for various validations (e.g. age-or gender-specific diagnoses and/or procedures) and linkages between specific diagnoses and procedures. These systems can usually also automatically allocate a Casemix group to a patient on completion of the coding. More sophisticated systems that automatically code natural language are in development. Automated linkages of such systems into hospital or funder information systems is also possible.

Data access and extraction

One of the biggest headaches facing coders is access to the required details in a medical record. Most medical information, especially in hospitals, is poorly documented, if at all, and lies in various poorly organised, hand written, disparate files. For example, in South African private hospitals, a patient's clinical record is kept by the attending physician, and nursing and theatre records are kept in the hospital file. Should the patient be seen by more that one provider, the clinical record is split between these providers!

This problem can be addressed in hospitals to some degree by enforcing the timely and accurate completion of a well-structured discharge summary. Coders can then use these discharge summaries for coding purposes. The use of well-structured and comprehensive medical records, e.g. the Problem Orientated Medical Record (POMR), could also add significantly to enabling the data extraction and coding process and, at the same time, add great value to the overall clinical management process.

Electronic medical records are clearly the ideal and are being increasingly widely used internationally despite their complexity and cost.

Resource usage data for development and modification of Casemix Groupings

Accurate and unbiased local resource usage data are essential for the initial establishment and ongoing modification of any Casemix grouping to ensure its local validity and acceptance by all role players as a management tool.[12]

If length of stay (LOS) is to be used as a proxy for resource use, it is essential to have a national standard definition and formula for the calculation of LOS which is implemented in all appropriate systems. This apparently simple issue turns out to be more complex than one realises, and currently there is no such standard in South Africa. The establishment of such a standard is, however, being addressed currently by the public sector Data Dictionary initiative. Decision makers will have to ensure that once established data standards are implemented as soon as possible.

LOS, however, is limited as a proxy for resource utilisation. Proper resource costing is the gold standard but is rarely readily available prior to the introduction of Casemix.[17] Individual billing data, when available, are widely used as a better proxy for costs than LOS.

It must be stressed that these data are required for the development and ongoing modification of a Casemix grouping tool. The use of this tool for Casemix management purposes requires other data (which may include LOS, costs, prices, etc.) to be linked to these groups, once they have been established and implemented, for comparison and analysis purposes. Management have to

decide what other data are to be linked to the groups and how these are to be used for management purposes.

Casemix development approaches

As stated above, countries other than the USA have followed one of two routes in their development of Casemix groupings for local use:

- One approach is to select one of the many groupings available in the USA or internationally, modify it for local coding practices and resource utilisation patterns (see Appendix II), and then further modify and develop it over time to ensure best local clinical coherence, cost weightings and predictive value.
- The second is to develop their own indigenous system. Though these systems, in the longer term, tend to have better local predictive value, in the short term this is not necessarily so.[12] They also require significant funding, time and expertise to implement.

Care needs to be taken, however, in such decision making. Issues that need to be taken into consideration include:

- **Choice of a single grouping model for use nationally.**
  Because of the complexity and costs of establishing and ongoing modification and development of a Casemix tool, as well as to ensure comparability, few countries other than the USA have more than one set of groupings used nationally. It is therefore essential for all role players, in both public and private sectors, to participate in such a project and to agree on a way forward for the establishment of a single national South African grouping.
- **Licensing, pricing and ownership.**
  If the agreed approach is to use an established grouping model, issues such as the following need to be taken into consideration:
  - Proprietary ownership vs. public domain.
  - Licensing.
  - Price.
  - Inclusion or exclusion of doctor costs.
  - Similarity of medical practice to that in South Africa.
  - International support availability.

Resources for development and modification of a Casemix tool

The development and ongoing modification of any Casemix grouping also has a number of requirements which include:

- A policy and management body composed of senior decision makers from both private and public sectors to establish guidelines, policy, priorities and to monitor progress of the project.
- A dedicated project team with the appropriate expertise and resources, functioning within the context of the nationally agreed policy and approach, to establish and maintain the Casemix groupings and ensure an appropriate tool is developed for the industry.

- A broadly based body of knowledgeable and enthusiastic clinicians to supply the clinical input required to ensure best possible clinical coherence within a South African context.
- An acceptable source of accurate and unbiased resource use information. Length of stay data may be used as a proxy in the short term. A better methodology would be to use private sector billing data sanitised to ensure that personal and corporate identities remain confidential. In the longer term, the best would be confidential, true cost information from both private and public sectors.
- Technology such as data warehousing and statistical analysis tools for the storage and analysis of Casemix related data, particularly for the development of comprehensive cost weights.

Resource and Management Process Requirements

There is little sense in embarking on such a project if infrastructure issues are not dealt with concurrently. These include:

- Posts will need to be established and filled by appropriately trained coders and coding audit personnel.
- Managers and clinicians will have to be trained in the issues relating to and use of Casemix.
- Management structures will need to be reorganised to include administrators, healthcare providers (e.g. doctors, nurses, etc.) and community representatives to ensure joint review and decision making regarding efficiencies and effectiveness of healthcare processes in their facilities (see Appendix I).
- Information system planning, procurement and implementation to provide the appropriate information to support such management processes.

Implementation drivers

This is probably the most important of all these issues. Classifying patients into Casemix groups is not an end in itself .[7] In most countries where Casemix has been introduced, its implementation has been mandated by large funders, either governmental or private, once they have ensured that the appropriate Casemix model and data collection systems are in place. One of the implementation drivers locally is likely to be the requirements of the recently-published Medical Schemes Act (131 of 1998) and the associated regulations (published 7 May 1999). The diagnosis/treatment combinations defined in the minimum benefits list included in the regulations should be taken into account in the development of South African Casemix groupings.

It is in the linkage to other data and the use of such information in management that Casemix plays its role. Senior decision makers need to decide up front as to:

- The potential value of this tool.
- How it is to be used, e.g. for budgeting, billing, costing, benchmarking, strategic planning, resource management, clinical audit, quality management, etc.
- Whether the benefits gained will outweigh the costs of implementation.

Such decisions will need to be part of their policy making and strategic plans will also have to address all these issues. If there is not the commitment from senior decision makers that this is a worthwhile project and if consensus decisions are not taken as to what will happen by when, then the process is unlikely to succeed.

RECOMMENDATIONS

Recommended Activities

The following activities are suggested as being essential for successful Casemix development in South Africa:

1. **Build understanding and buy-in from senior decision makers in both private and public sectors.**

   The MRC will:
   - Circulate this report to as many public and private sector healthcare decision makers as possible. Copying and onward circulation will be encouraged as long as the source of the document is acknowledged.
   - Present this report formally to NHISSA, PHISC and SABS.
   - Present this report formally to specific stakeholders if requested to do so, provided resources are available, e.g. to attend a meeting outside Cape Town.

2. **Establish approaches and mechanisms for decision making about Casemix development and maintenance for South Africa.**

   It is recommended that a national Casemix workshop, involving all appropriate role players, be convened as a matter of urgency in order to obtain national consensus as to approaches and mechanisms for decision making about Casemix development and maintenance in South Africa. This will also contribute to building understanding and obtaining buy-in.

   2.1. The aims of the workshop should be to establish:
   - The value of Casemix as a clinical, administrative and operational healthcare management tool, and potential billing mechanism, e.g. private sector, social health insurance, etc.
   - A mechanism for deciding on a national procedure coding system.
   - An approach to the establishment of an appropriate national Casemix grouping for South Africa.
   - Mechanisms for decision making and project guidance, e.g. the establishment of a national Casemix steering committee.
   - Recommendations for the establishment of a national Casemix project team.
   - Sourcing of funding for the project.

2.2. The following should be invited to attend:
- Public sector representatives.
- Private sector representatives.
- Interested clinicians, representatives from professional bodies and/or various institutions.
- A limited number of local and international experts capable of advising both on issues of procedure codes and a way forward for South Africa.
- Potential funders.

2.3. The workshop should be held over two days:
- Day one would be a briefing day open to all. Experts, who would have been fully briefed prior to the workshop, would be requested to present their experience and opinions as to what procedure codes would best suit South Africa within a Casemix context, and a recommended approach to developing a Casemix tool for South Africa, including structures and resources.
- Day two would be a facilitated workshop limited to selected participants with the view to agreeing on the goals outlined above with input from the international and local experts.

2.4. Funding for the workshop should be sought from all appropriate sources, both nationally and internationally, and could be augmented by an admission fee for day one participants.

Recommended Approach to the Development of an appropriate Casemix Grouping for South Africa

1. Modify an existing grouping

Based on available information, and on consensus among people currently active in this field in South Africa, it is recommended that one of the many groupings available internationally be selected and modified for local coding practices and resource utilisation patterns. This would be a much quicker, and potentially much less costly, route than developing a grouping from scratch. It would probably require an appropriately structured and resourced project team no more than 6 to 12 months to deliver a fully functional first version of a grouping for use in South Africa.

2. Focus on an acute inpatient grouping first

With the limited resources available in South Africa, it would make most sense to focus initially on an acute inpatient grouping, as inpatient services are the most costly services in both public and private sectors, and are therefore most in need of such a tool. In much the same way that the UK has approached the problem, once local Casemix expertise has been developed and such a grouping has been

successfully implemented, other components of healthcare such as outpatient treatment, community health and healthcare need groupings could be addressed.

3. **Develop a single, national, inpatient grouper**

   Choice of a single grouping model for use nationally will require all role players, in both public and private sectors, to participate in such a project and agree on a way forward for the establishment of a single, national South African inpatient grouping.

4. **Licensing, pricing and ownership issues must be considered**

   If the agreed approach is as above, the following issues all need to be taken into consideration as early as possible in the selection process:
   - Proprietary ownership vs. public domain.
   - Licensing.
   - Price.
   - Inclusion or exclusion of doctor costs.
   - Similarity of medical practice to that in South Africa.
   - Availability of international support.

5. **Commence with one or two pilot sites**

   Furthermore, to ensure the buy-in of senior decision makers, it is also recommended that the project commences with a few, well-planned, documented and scientifically evaluated pilot projects. The outcomes of these projects could be referred to a steering committee composed of appropriate decision makers for consensus on how best to proceed.

CONCLUSION

The prime goal of any information system should be to support management processes, especially in ensuring efficiency and effectiveness. With the huge investments in health information systems currently occurring in both public and private sectors in South Africa, it is essential that their design and functionality meets these management requirements. Casemix has been widely shown to be a fundamental tool for both clinical and administrative management of healthcare. However, the introduction of Casemix requires vision, understanding, commitment, careful planning and consensus between role players as it is neither an easy, quick or an inexpensive process to implement, involving many issues. These issues, however, are not insurmountable.

Thus, if senior decision makers guiding the future of healthcare in South Africa wish to empower their own decision making, and that of their subordinates, the first steps down a Casemix path need to be taken. The requirements for this journey and the route to be taken could be resolved at a national workshop, as recommended in this report.

Implementation of new healthcare management processes and related information system support is challenging, but it is something that we need to tackle head on if we are to conquer this complex and rapidly evolving business of healthcare management.

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APPENDIX I

SYSTEMS THEORY FOR HEALTHCARE MANAGERS

Introduction

During the 19th and early 20th centuries, as industrialisation swept the world, a number of approaches to management problems were developed.[18, 19] These classical approaches include systematic management, scientific management, administrative management, human relations, bureaucracy, quantitative management and organisational behaviour approaches. Though each of these approaches had their impact, they were all shown to be consistently lacking in two areas, i.e.:

1. They ignored the relationship between the organisation and its external environment.
2. They usually addressed one aspect of the organisation or its employees at the expense of others.

In the 1950's, in an attempt to address these deficiencies, principles of general systems theory were applied to the management of organisations, i.e. when viewed as a system, organisations were seen as a set of interdependent elements which were, in turn, interdependent with the external environment. With the introduction of systems principles, corporations began to recognise the role of effectiveness, i.e. the degree that the actual outputs of the organisation corresponded to the outputs that organisations and individuals wanted in the external environment.[18, 19] This was the beginning of an understanding of the principles of quality management and the need to balance this with efficiency.

General Principles of a Systems Theory Approach to Management.

A system can be defined as a collection of parts and/or processes which interact with each other to function as a whole (see Fig. 3).[20]

All systems have:

- A **structure,** i.e. one or more interdependent elements within a clearly defined boundary.
- **Inputs** to the system (i.e. resources). These usually include human (labour), physical (materials), financial and information resources.[18]
- Internal **transformational processes** which are the prime functions of the system's elements.
- **Outputs** or products of the system. These can be physical products and/or services.
- **Feedback or control** mechanisms. In order to ensure that a system remains optimised and in balance in its production of outputs, i.e. the **outcome** of the process is as good as possible, feedback mechanisms are essential.

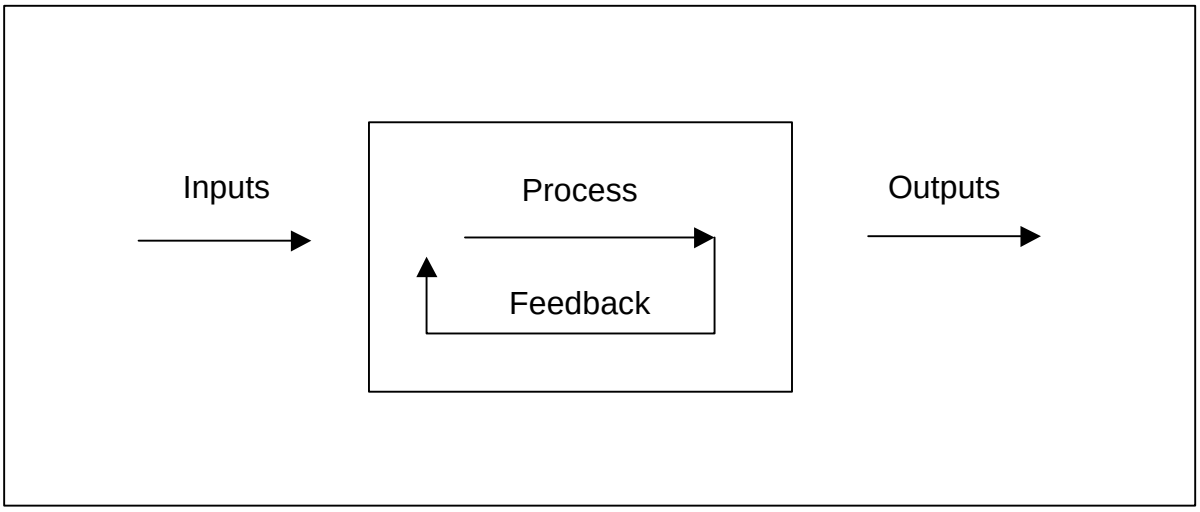

Fig. 3 – Systems Theory Basics

Four basic systems concepts apply to all organisations[18], i.e.:

1. Whether they are **closed** or **open** systems. A system is closed when it is self-supporting and can exist independently of its environment. A system is open if:
   - It is dependent on the environment in which it operates.
   - The environment is dependent on the system.
   - There is a specific interaction between system and environment.

   Most organisations are open systems.

2. Organisations contain **subsystems.** Most organisations can be divided into three types of subsystems.[19] These are:
   - **Operational subsystems**. These are often called the technical core of the organisation, performing the transformation of inputs into outputs.
   - **Tactical subsystems**. These consist of middle management and support services that facilitate and co-ordinate the work of the operational subsystems.
   - **Strategic subsystems**. These are composed of the organisation's senior management, and are primarily concerned with major interactions between the organisation and the critical elements of its external environment. This enables an organisation to adapt to environmental changes and to influence the environment in which it functions.

3. **Synergy,** i.e. the whole is greater than the sum of its parts. This results when various sections or functions within an organisation co-operate as subsystems and thus become more productive that would be the case if they functioned independently.

4. **Entropy** is the opposite of synergy, i.e. it is the tendency of all systems to disintegrate. In order to survive, an organisation must continually evaluate its environment and adapt to changes or it is doomed to disintegration and failure.

Within the context of business systems, these feedback or control mechanisms involve the generation, evaluation and appropriate response to information about resource utilisation and quality standards. At a simplistic level, these are the prime functions of modern management.

Most organisations (see Fig. 4) develop effective means to deal with entropy through feedback or control mechanisms. Two areas of fundamental management focus that are aimed at ensuring optimal outcomes for organisational outputs and thus minimising entropy are:

- **Efficiency** - which is an economic concept and can be defined as the optimal use of inputs (especially in monetary terms) in the production of any **given** output, i.e. cost management, and,
- **Effectiveness** - which is the ability of any given process to achieve success in producing given results or to meet predetermined goals for a **given** output, i.e. quality management.

It is important to note that, in assessing efficiency and/or effectiveness, it is essential that this is done for a given, clearly identifiable output. It is also important to note that, as is illustrated in Fig. 4, management has decision-making powers over the whole system, i.e. inputs, transformation processes and outputs, as well as the outcome (or quality) of the outputs.

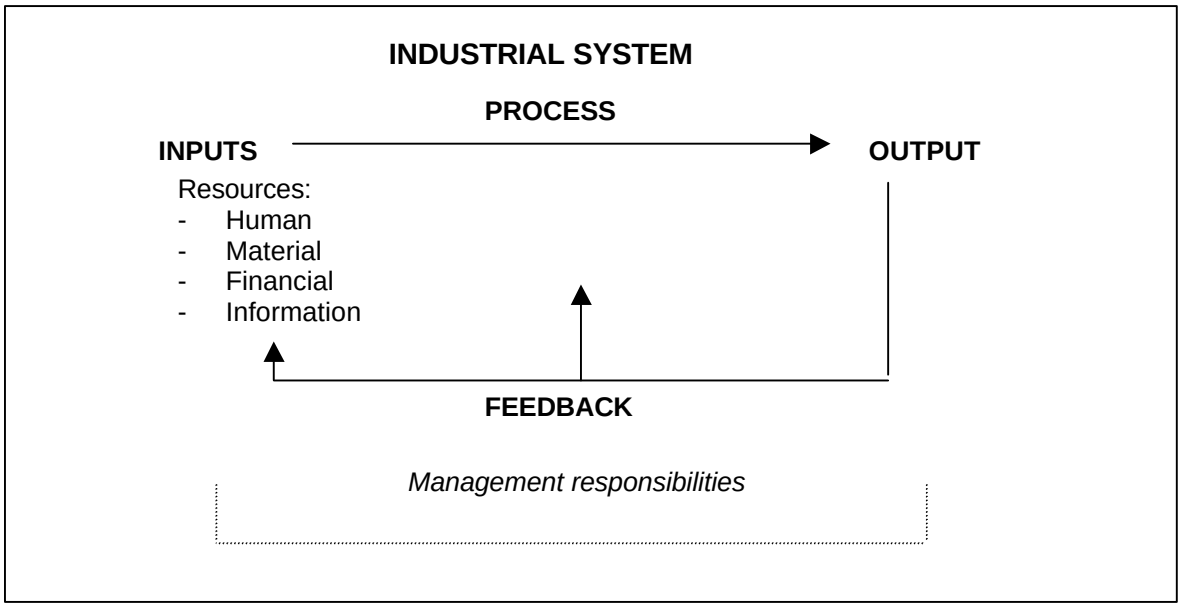

Fig. 4 – Systems Theory in Industry

Systems Theory and Healthcare Management

Healthcare management involves both clinical management of individual patients as well as the more general administrative management of providers, medicines and materials, facilities, etc. Healthcare management is essentially the application of appropriate management principles as described above in the more complex environment of healthcare in an attempt to ensure affordable, accessible, quality healthcare. Thus, in order to ensure efficient and effective healthcare, it is essential to have detailed information about healthcare inputs, processes and outputs as well as outcomes.

It is therefore clear that healthcare management is information driven.

A healthcare system structure (see Fig. 5) includes:

- Healthcare funding subsystems,
- Healthcare delivery subsystems, and,
- Healthcare management sub-systems - including clinical and administrative management at operational, tactical and strategic levels.

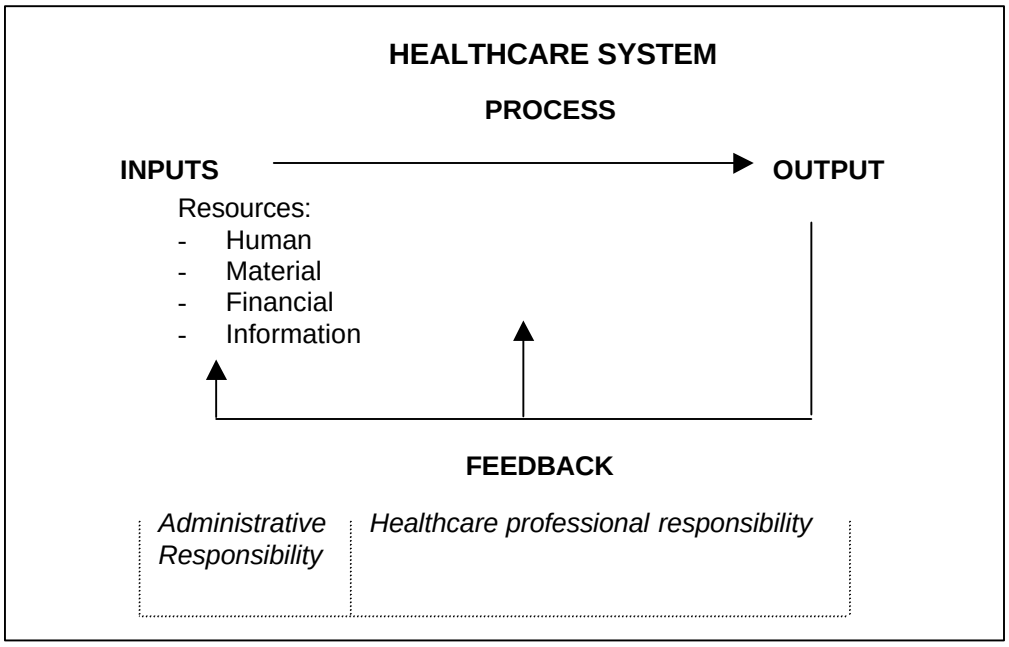

Fig. 5 – Systems Theory in Healthcare

It is important to note a major difference between Fig. 4 and Fig. 5:

- Fig. 4 represents a normal industrial system, e.g. car manufacturing. In such a system management has full control over the inputs, process and outputs (both volumes and quality) and therefore has the capacity to continually review and control the costs and quality of the products being produced.

- Fig. 5 represents the healthcare industry situation as it is commonly found. Under these circumstances management only has a limited control over inputs. Healthcare professionals, especially doctors, usually determine the course of and resources used during the clinical process but have no responsibility for the efficiency of the system, i.e. cost control, and little to no information as to the effectiveness of their interventions. In systems terms, there is a lack of synergy between management and provider subsystems, and a lack of appropriate control information. This is a prime cause of inadequate healthcare management worldwide. Thus, effective healthcare management will require that these structural and feedback issues be dealt with in such a way that patients, healthcare managers and providers jointly manage the healthcare system as partners, sharing information and decision-making responsibilities, thus ensuring synergy and the continual improvement of their healthcare system.

Modern Healthcare Management - Data & Coding Implications

A typical clinical process is as follows. An individual with a healthcare problem enters a healthcare system. This usually starts with a consultation which commences with the patient explaining his or her **reason/s for encounter (RFE)**, e.g. symptoms, concerns, needs, etc. The patient is then examined and the signs and findings are recorded. The healthcare provider then makes some assessment as to what the healthcare problem is likely to be and also what to do about it. This could include various investigations and/or treatments. The patient's progress is then monitored as part of this healthcare process until the problem is stabilised or resolved and the patient leaves the system. Efficient and effective clinical and administrative management of such a process requires data and information about all these activities. Currently most of this information, if documented at all, lies in various poorly organised, hand written, scattered medical records.

A healthcare **episode** is the period from when an individual develops a health problem until that problem is resolved. During that episode the patient may have one or more **encounters** with various healthcare providers and/or facilities.

Diagnoses define an individual's healthcare problem in medical terms. Diagnoses can be:

- **Principal diagnosis** - i.e. the main reason for an individual entering a healthcare system.
- **Complications** - i.e. healthcare problems that did not exist prior to the onset of the principal healthcare problem and are usually associated with or a result of the principal diagnosis.
- **Comorbidities** - i.e. healthcare problems that existed prior to the onset of the principal healthcare problem and coexist, but are not necessarily associated, with the principal diagnosis.

Complications and comorbidities are often abbreviated to '**CCs'**.

Procedures are activities which are carried out as part of the healthcare process to clarify and/or resolve the healthcare problem. Procedures can be:

- **Cognitive** - i.e. consultations,
- **Investigative** - e.g. pathology, radiology, etc.,
- **Therapeutic:**
    - **Surgical** - e.g. operations, or,
    - **Medical** - e.g. radiotherapy.

Medicines and/or **materials** may also be used in the resolution of a patient's healthcare problem.

The **quality** of a healthcare process is a measure of the 'goodness' of the outputs, i.e. **outcome**, of that process. Parameters that are established to measure various dimensions of quality in healthcare are **outcome measurements or indicators.**

Casemix is the mix of cases of a hospital or other health service, i.e. the range and type of patients a hospital or health service treats.[7] When formalised**,** a hospital or health system's Casemix is seen as its output which has been scientifically classified into predetermined categories for which a set of codes and descriptions has been allocated.

In order to manage healthcare, remembering that the definitions of efficiency and effectiveness require 'a given output', it is essential to have a mechanism or tool that can define a manageable number of clearly defined healthcare output categories.

Casemix groupings are therefore essential for managers and healthcare professionals to begin to understand the healthcare system and to begin addressing efficiency and effectiveness issues that have for so long eluded them. It must be stressed, however, that these are **grouping** tools, i.e. they group data elements such as diagnoses, procedures, etc. and are thus wholly dependent on the availability, completeness and accuracy of such data.

Therefore, in order to manage healthcare resources it is necessary:

- To document fully the episode and all related encounters.
- To identify as far as possible all the patient's reasons for encounter and diagnoses, and differentiate between primary diagnoses and CCs. These all need to be clearly and accurately documented.
- To document all procedures, medicines, materials and any other resources (including costs if possible) used during the healthcare process.
- To measure and document the outcome of that process.
- To group patients and all related data into output categories.
- To compare the processes, costs and related outcomes of various like healthcare outputs in order to determine best practice in terms of efficiency and effectiveness. This is the core of the Cochrane concept of evidence-based medicine (EBM).

- From this information, to develop and update clinical guidelines, protocols, critical care pathways, etc., thus ensuring continuous quality improvement in the healthcare environment.

It would be impossible to carry out all of the above without the data capture, storage, collation, analysis, output, distribution and communication capabilities of modern computerised information systems. However, computers are not very efficient at storing or manipulating long descriptions which are often associated with diagnoses, procedures, medicines, materials, etc. By coding these and other descriptors, storage and computation is much more efficient. Thus, codes are also a critical element of effective healthcare management.

Such coding systems are usually one of the following:[21]

- **Nomenclatures.** These are coding systems that are used in a process of **terming**, i.e. they are a unified attempt to code, at a detailed level, all aspects of the clinical process (e.g. READ, SNOMED, etc.). These are used for recording patient care in electronic medical records and clinical management.
- **Classifications.** These coding systems are usually used in the process of **encoding**, i.e. they are hierarchical structures in which like items are grouped (e.g. ICD, ICPC, CPT, etc.). These may be used for statistical analysis, billing, operational management, etc.
- **Clinical groups.** These are codes that are always derived from the **grouping** of various diagnosis and/or procedure codes (in some cases, together with a few other data elements, e.g. age, gender and discharge status) and define the output or product of a healthcare process. These may be used for costing, billing, quality management, strategic management, Casemix management, etc.

An awareness of these issues in general and, in particular, of the need for an appropriate output definition tool has had a fundamental impact on healthcare management worldwide. First and Third World countries alike are investing in health information systems and tools to address these issues with the growing awareness that, without such systems and tools, healthcare is essentially unmanageable.

APPENDIX II

CASEMIX GROUPINGS – TECHNICAL DETAILS

Briefing Box – Early history of DRGs

DRGs were created in the late 1960's at Yale University by Prof. RB Fetter and his colleagues as an inpatient classification system that differentiated the amount of hospital resources required to provide care.[9]

- First 'Patient Groups' (1973):
  - 54 MDCs.
  - 333 Final groups.
- Second version (1977) developed under contract with the Social Security Administration:
  - 83 MDCs.
  - 383 DRGs.
- Third version (1978) developed for State of New Jersey:
  - Surgical procedure problems of second version corrected.
- Medicare DRGs (1980 - 1982) developed under contract with HCFA for the Medicare Prospective Payment system, using HCFA claims details to determine resource usage:
  - 23 MDCs.
  - 468 DRGs.

Medicare DRGs

The Medicare DRGs classify patients based on the amount and type of hospital resources needed to treat a patient. Medicare DRGs are not differentiated by severity of illness, prognosis, treatment difficulty or need for intervention. Their design and weightings reflect the Medicare population base, i.e. the elderly in the USA, and exclude physician costs.[2]

Medicare DRG design objectives were:

- Each DRG had to have similar clinical characteristics, i.e. be clinically coherent, e.g. have a common organ system, aetiology or clinical specialty.
- Recognising that patients allocated to a DRG are not identical, each DRG had to have similar patterns of resource use and had to predict an average level of resource use.
- A manageable number of DRGs, i.e. limited to hundreds not thousands of DRGs.
- Limited to information routinely collected in hospitals in the US and used for fee-for-service billing.

The data elements used to construct Medicare DRGs were:

- Principal diagnosis, i.e. the diagnosis established to be chiefly responsible for the admission of the patient to the hospital.
- Secondary diagnoses or CCs, i.e. complications and comorbidities.
- Procedures/operations.
- Age.
- Gender.
- Discharge status.

The ICD-9-CM Diagnosis and Procedure Coding System was the clinical coding system used as the basis of the DRG grouping. ICD-9-CM diagnosis codes are organised into Major Diagnostic Categories (MDCs) which are based on organ systems, e.g. respiratory, central nervous system, digestive system, etc.

Medicare DRG allocation:
The first step in forming the Medicare DRGs was to divide all possible principal diagnoses into mutually exclusive Major Diagnostic Categories (MDCs) based on organ systems. This process was accomplished by physician panels.

Secondary diagnoses are made up of complications (a condition which did not exist prior to the admission) and comorbidities (a condition which existed prior to admission). A significant complication or comorbidity is a secondary diagnosis which would be expected to extend the patient's length of stay by at least one day in at least 75 % of patients. All medical and surgical patient classes in each MDC were evaluated to determine if the presence of a significant complication or comorbidity consistently affected the use of hospital resources. From this exercise a Complication and Comorbidity (CC) Exclusion List was formulated, e.g.:

- For a principal diagnosis of bladder neck obstruction:
    - Urinary retention is not a CC.
- For a principal diagnosis of general convulsive epilepsy:
    - Convulsion is not a CC.

All ICD-9-CM procedure codes were classified based on whether or not they required the use of an operating theatre or special operating theatre type facility, e.g.:

- Operating theatre procedures:
    - Cholecystectomy.
    - Cerebral meninges biopsy.
    - Open heart valvuloplasty.
- Non-operating theatre procedures:
    - Thoracentesis.
    - Bronchoscopy.
    - Skin sutures.

Since the presence of a surgical procedure requires different hospital resources (operating theatre, recovery room, anaesthesia) most MDCs were divided into surgical and medical groups based on the presence or absence of a surgical procedure requiring an operating theatre.

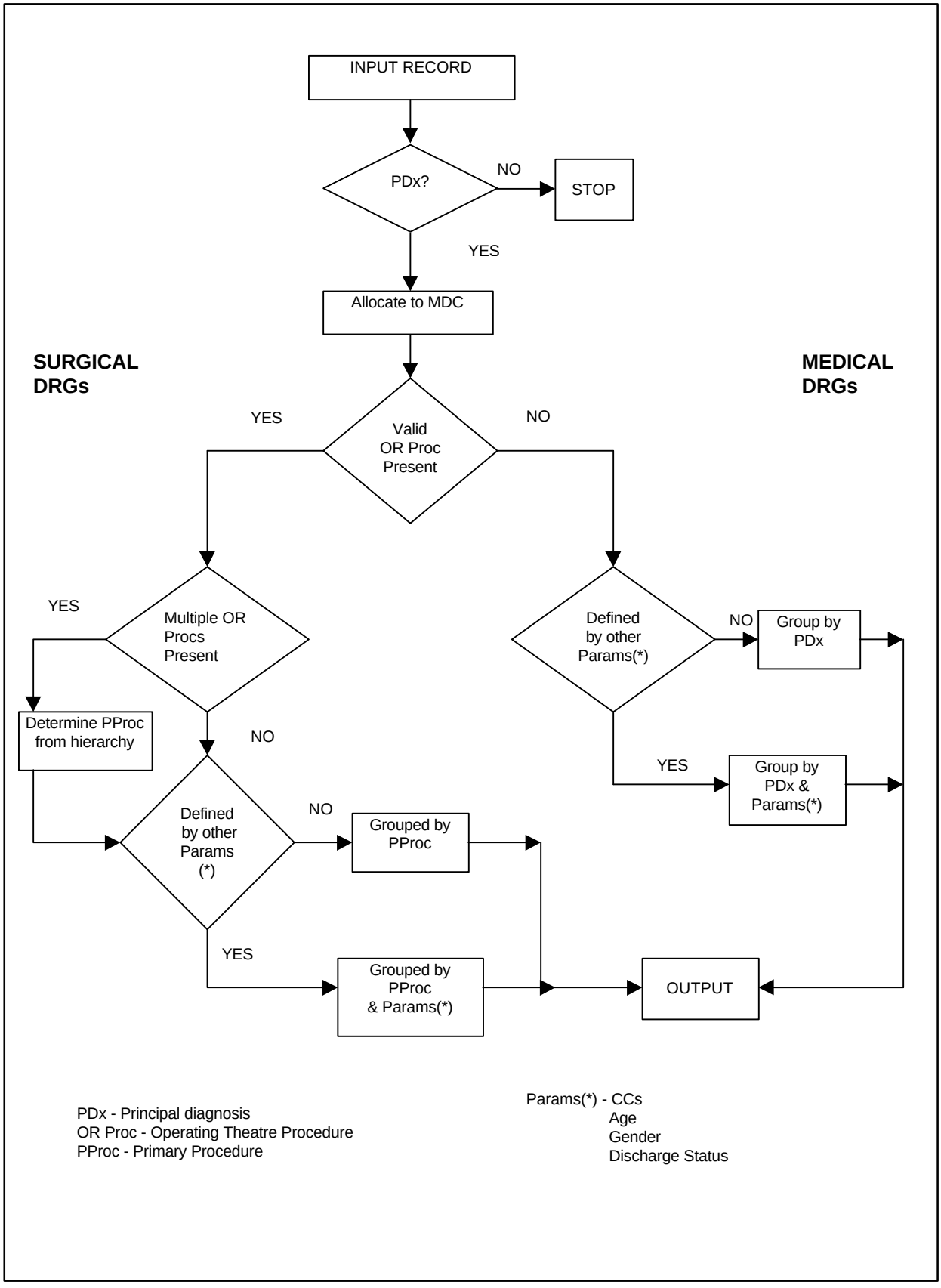

Fig. 6 - DRG Decision Tree

If multiple procedures are present, the patient is assigned to a single surgical DRG based on a surgical hierarchy within each MDC, e.g.:

- Kidney transplant.
  - Major bladder, kidney and ureter procedures.
    - Minor bladder procedures.
      - Other procedures on the kidney and urinary tract.
- Transurethral procedures.
  - Urethral procedures.
    - Prostatectomy.

When all the operating theatre procedures performed are unrelated to the patient's principal diagnosis one of three unrelated procedure DRGs are assigned, i.e.:

- Extensive procedure unrelated to principal diagnosis.
- Prostatic procedure unrelated to principal diagnosis.
- Non-extensive procedure unrelated to principal diagnosis .

When there is no operating theatre type surgical procedure, the patient is assigned to a single medical DRG based on the principal diagnosis and CCs.

All medical and surgical patient categories in each MDC were also evaluated to determine if age, gender and/or discharge status consistently affected the use of hospital resources. If so, they were incorporated into the DRG structure.

Version 14.0 of the Medicare DRGs was effective from 1 October 1996 and contained 490 DRGs.

Since 1983, when Medicare adopted the DRGs, all Medicare DRG changes have focused on the Medicare population, i.e. the elderly in acute stay hospitals. It has been recognised that they are deficient in a number of areas if they are to used for the general population, e.g. Paediatrics, Obstetrics, etc. These limitations in the DRG definitions relating to the non-Medicare population have not been addressed in the Medicare DRGs, thus there was a need to develop other Casemix tools that addressed these deficiencies.

All Patient-DRGs (AP-DRGs)

On 1 January 1988, the New York State Department of Health (NYSDH) began paying all non-Medicare hospital discharges on a prospective DRG based payment system.[9] The initial conclusion of the NYSDH was that the Medicare DRGs were inadequate and they therefore entered into an agreement with a commercial organisation, 3M Health Information Systems (HIS), to develop a new version of the DRGs to be called All Patient DRGs (AP-DRGs). The changes incorporated into this Casemix system included:

- **MDC assignment**. The initial step in the determination of a DRG is the assignment to the appropriate MDC based on the principal diagnosis. In some

cases, the AP-DRGs use procedure, secondary diagnosis and age as the basis for exceptions to principal diagnosis based MDC assignments.

- **Major CCs used as a proxy for severity**. Using extensive Length of Stay (LOS), financial data and clinical input, a subgroup of major CCs was developed from the CC list. These major CCs resulted in significantly increased resource utilisation and were thus seen as a proxy for severity. Within each MDC patients with major CCs (e.g., AMI, CVA, etc.) were assigned to separate AP-DRGs, e.g. there were a total of 60 major CC AP-DRGs in Version 12.0.
- **Other AP-DRG major improvements**. These included:
    - New HIV infection and multiple trauma MDCs.
    - Restructuring of newborn MDC based on birth weight, and restructuring of the alcohol/drug abuse MDC.
    - New DRGs created for:
        - Tracheostomy.
        - Transplants.
        - Ventricular shunt revisions.
        - Cystic Fibrosis.
        - Lead poisoning.
        - Paediatric patients.
        - High-risk obstetrical patients.
    - Numerous other DRG modifications.

AP-DRGs have been updated in January of every year since their inception in 1988. These annual updates also include all the Medicare DRG updates. In Version 14.0 there were 639 AP-DRGs.

AP-DRGs are used as the basis for prospective payment systems in the states of New York, Maine, Massachusetts, Washington, North Carolina and Indiana. They are also utilised by Blue Cross/Blue Shield managed healthcare plans in Massachusetts, Washington and New York.

All Patient Refined DRGs (APR-DRGs)

APR-DRGs are proprietary to 3M Health Information Systems.[14] They are based on AP-DRG principles and were designed to specifically address:[9]

- **Severity of illness**, i.e. the extent of physiologic decompensation or organ system loss of function.
- **Risk of mortality**, i.e. the likelihood of dying.
- **Resource intensity**, i.e. the relative volume and types of diagnostic, therapeutic and bed services used in the management of a particular disease or disorder. As per DRGs and AP-DRGs, they exclude physician costs.

The initial approach was to take AP-DRGs and create so called Base APR-DRGs by:

- Recombining AP-DRG splits, e.g. age, CCs, major CCs, etc., into base DRGs.
- Consolidating AP-DRGs distinguished by the presence of a complicated principal diagnosis (e.g. complicated versus uncomplicated appendicitis).

- Consolidating low volume AP-DRGs.
- Some reassignment of diagnoses and procedures among the base DRGs.[9]

These base APR-DRGs are enhanced by the inclusion of four 'Severity of Illness' and 'Risk of Mortality' subclasses within each base DRG.[14] These four subclasses are Minor, Moderate, Major or Extreme. They are allocated according to sophisticated clinical algorithms that simultaneously evaluate multiple CCs, age, procedures and principal diagnosis. It has been shown that these algorithms ensure that patients allocated to these subclasses experience similar resource utilisation and outcomes.

APR-DRG Version 15.0[22] was released in April, 1998. It consists of 357 base APR-DRGs, each with four severity subclasses, giving a total of 1422 APR-DRGs.

Outpatient or Ambulatory Groupings

The use of Casemix tools has added significant value to inpatient care and management. However, there has been relatively little work on developing groupings for outpatients and/or ambulatory or primary care patients. In addition, those that have been developed have not been widely used.[2] There are a number of possible reasons for this, including:

- Relatively low patient costs in these settings.
- A belief that outpatient activity and output is intrinsically more homogeneous than inpatient activity.
- The high cost of information gathering relative to the cost of the treatment episodes being measured.

Outpatient groupings that have been developed include:

- **Ambulatory Visit Groups (AVGs).** These were developed by the Yale group responsible for DRGs. It divides outpatient episodes by principal diagnosis into MDCs which are then further subdivided into AVGs.
- **Ambulatory Patient Groupings (APGs).** These are similar to AVGs, but grouping is initially dependent on procedure, rather than diagnosis.[2]

International Approaches to Casemix Grouping Development

The use of Casemix tools has spread worldwide. Countries have adopted one of two approaches in developing Casemix groupings appropriate to their requirements and healthcare practices, i.e.

1. Taking a US developed grouping model and modifying the groupings according to local clinical considerations and resource analysis. These modifications usually follow one of two approaches, i.e.:
   - **Mapped groupers.** In mapped groupers the local diagnostic and/or procedure codes are mapped to their ICD-9-CM equivalents and the results are run through the original grouper. For example, a mapped AP-DRG

Grouper is used in Sweden (ICD-10 Diagnosis codes and Nordic Procedure codes).

- **Native groupers.** In native groupers, the local or 'native' diagnosis and/or procedure codes are substituted for the ICD-9-CM codes in the DRG definitions. Native AP-DRG groupers are used in Wales (ICD-10/OPCS), Czech Republic (ICD-10/Czech Procedure codes), **and** Germany (ICD-9/German Procedure codes).[9] Canada is moving from ICD-9, ICD-9-CM and CCP (Canadial Classification of Procedures) to ICD-10/CCI (Canadian Classification of Health Interventions).[23]

2. Using similar principles to those in the USA, but building their own decision trees and groupings *ab initio,* e.g. HRGs in the UK.[8]

3M Health Information Systems is developing a generic Casemix grouper based on APR-DRGs for use internationally which could then be used as the core of a country-specific grouper.[9]

Australian National DRGs (AN-DRGs)

Australian National DRGs (AN-DRGs) have been developed under the auspices of the Australian Casemix Clinical Committee (ACCC) which was established in 1991[15] and are a good example of the first approach mentioned above. They are based on the HCFA Medicare DRGs and have been modified over time along the lines of AP-DRGs as a native grouper.

As with HCFA DRGs, a case is assigned to one of 23 MDCs primarily on the basis of the principal diagnosis. Subsequent allocation depends on whether a significant procedure (usually one requiring use of an operating theatre) was performed. This determines an allocation to a surgical or medical AN-DRG within the MDC. A predetermined hierarchy of surgical procedures determines the allocation when there is more than one significant procedure. In AN-DRG Version 3.0 use is made of Complicating Clinical Factors (CCFs), i.e. age, malignancy, complications and comorbidities as severity approximations to better meet Australian requirements. This AN-DRG version has 670 AN-DRGs[7] and includes physician costs.[23]

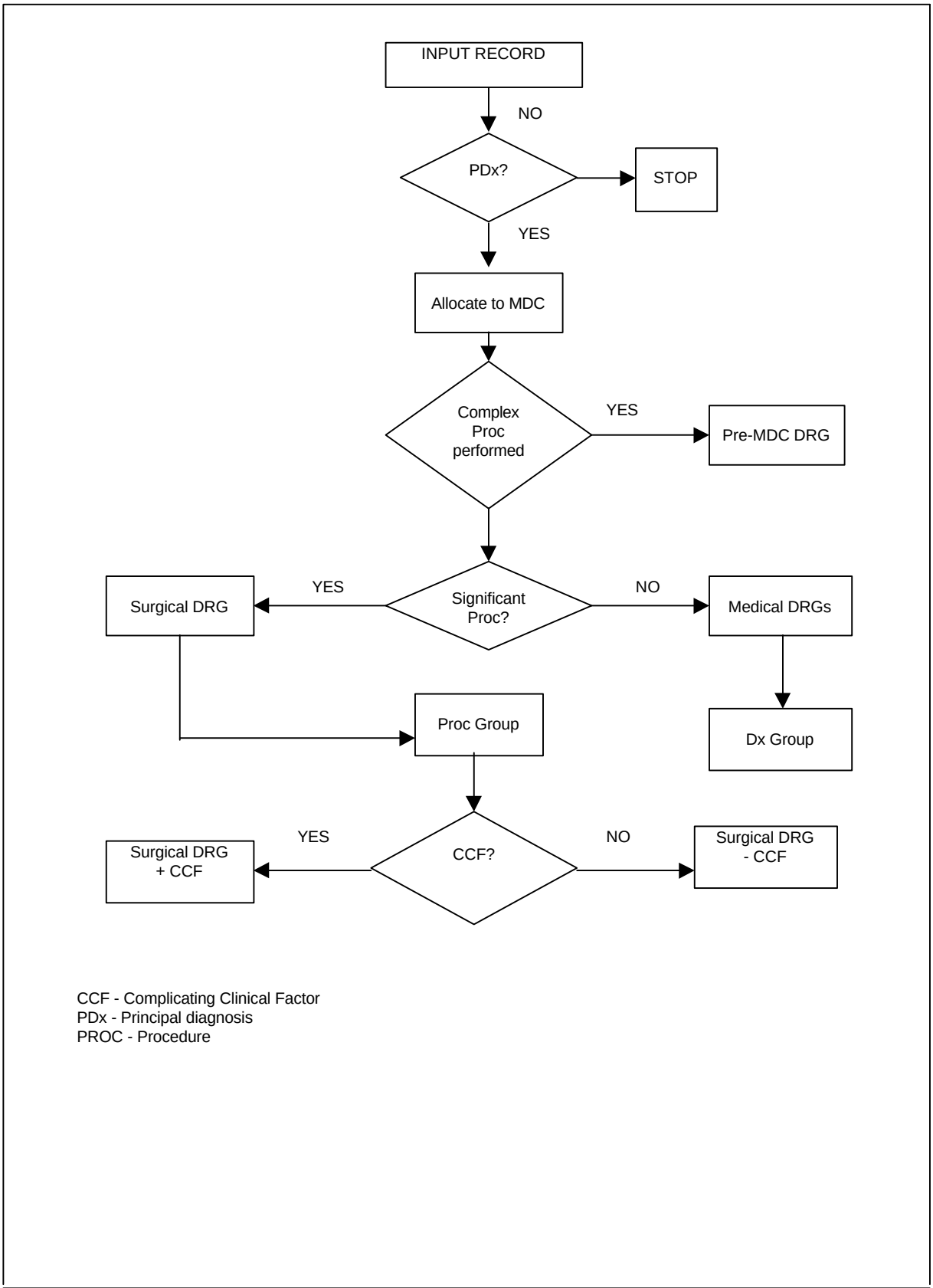

Fig. 7 - AN-DRG Decision Tree

UK Healthcare Resource Groups (HRGs)

The UK is a good example of a country which has followed the second route outlined above. In so doing, they have progressively developed a comprehensive grouping philosophy which includes inpatient, outpatient and community Health Resource Groups (HRGs) as well as Health Benefit Groups (HBGs).[1]

Casemix groupings in the UK commenced with the introduction of an English modification of DRGs.[2] A number of problems arose, however, including:

- Poor predictive performance in some areas because of differences in diagnostic terminology and/or clinical practice between the UK and the USA.
- The lack of UK derived cost weights.

Thus, the National Casemix Office (NCMO) was established to develop a unique set of UK Casemix groups and cost weights called Healthcare Resource Groups (HRGs). These were developed in the late 1980s and have undergone a number of revisions since then.[10, 16]

The NCMO followed the basic premises that:

- In addition, hospitals or health systems produce vast quantities of heterogeneous data which cannot provide useful information without being reduced to a manageable number of categories.
- Any attempt to base healthcare provision on population need (i.e. to move from a supply focus to a demand focus) must have a mechanism for defining and categorising conditions (i.e. need for care) in terms of appropriate treatments (i.e. activity) and likely outcomes (i.e. benefits).
- Healthcare management progress within the NHS is viewed as a three-tiered process:
    - Initially, to identify all the elements of service being supplied and to attach costs to them. This enables an understanding of how money is being spent across and within sectors and specialties. With this sort of information, managers can begin to make comparisons, review efficiencies and monitor changes.
    - Secondly, to identify healthcare needs and, using the information gained on the costs of the different services, examine how the money available might be more efficiently spent to serve that need.
    - Finally, to start to address the outcomes of healthcare provision and whether the greatest benefit possible is being achieved from the resources used.

HRGs are seen as a way of categorising the treatments of patients into groups that are clinically similar and use roughly the same level of resources for acute hospital inpatient and day-case treatments. Thus surgical procedures are used for the allocation of patients to surgical HRGs. However, for most medical episodes of care, there is not the same simple ‘driver’ of activity, the equivalent of the surgical procedure, which can be used to identify resource use. Thus principal diagnoses are used as a proxy for surgical procedures in patients allocation to HRGs. This principle holds true for most Casemix groupings.

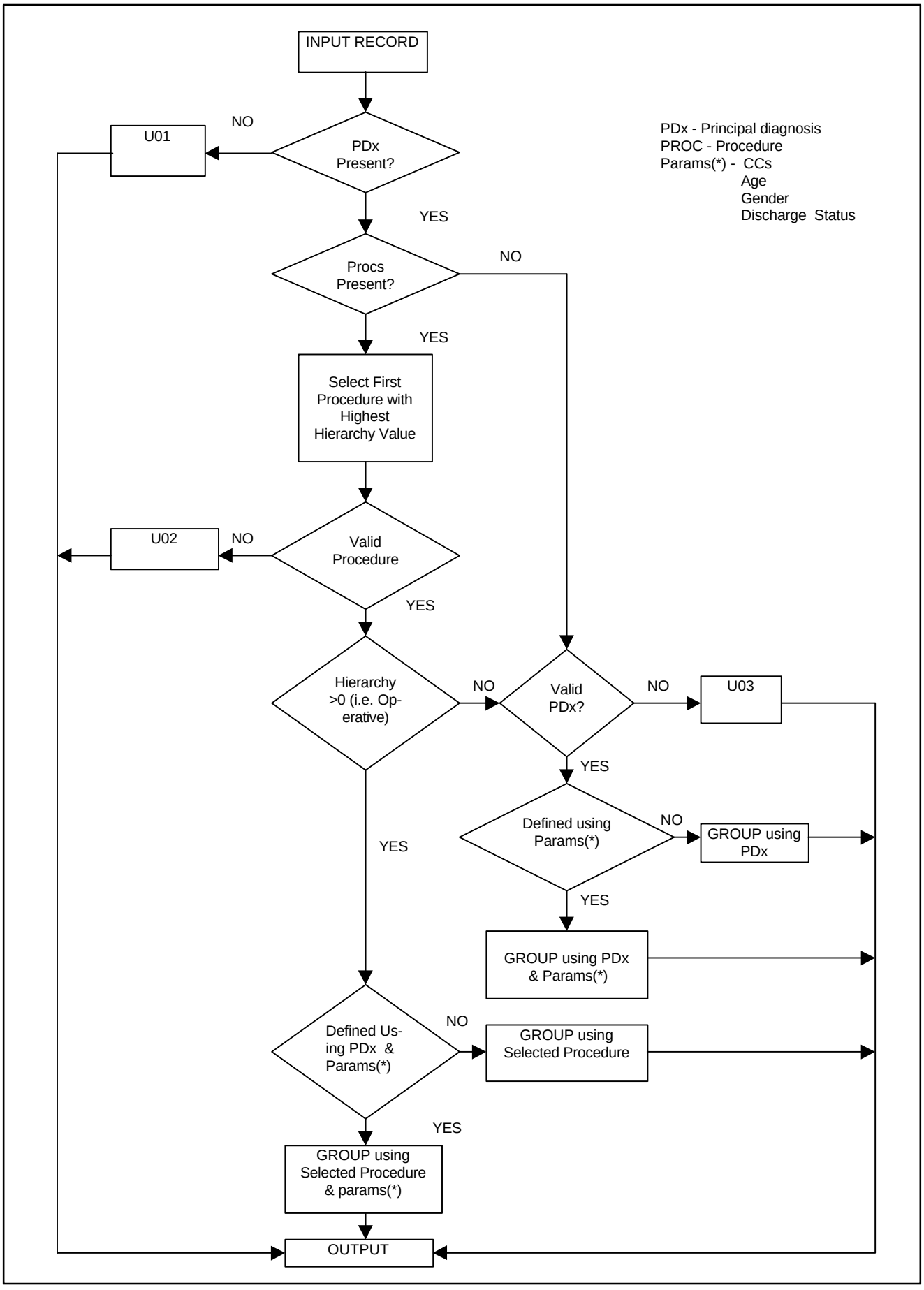

Fig. 8 - HRG Decision Tree [24]

In order to cover the full range of healthcare treatments and activities, the NCMO has recently commenced the development of:

- Outpatient HRGs to cover activities undertaken by consultants in outpatient clinics. These will include groupings for chemotherapy and radiology in due course.
- Community HRGs to cover the activities of health visitors, district nursing, midwifery, physiotherapy, occupational therapy, speech and language therapy and other ambulatory clinical disciplines. This work is being undertaken in collaboration with the development of care pathways, care profiles and read codes.[10]

These HRGs enable healthcare managers to address the first management goal outlined above, i.e. to clarify how money is being spent across and within sectors and specialties, and to go some way towards the second step of matching service provision to population need by examining hospitalisation rates by HRG.

It is clear, however, that other tools are required to enable healthcare managers to fully realise the second tier as well as addressing the final tier, i.e. that of measuring outcomes and maximising the benefits gained from resource provision. The NCMO is in the process of developing Health Benefit Groups (HBGs) to address this requirement. HBGs are designed to categorise the population in terms of its need for healthcare and, given appropriate care, its ability to benefit. Thus HRGs and HBGs will complement one another and together will empower managers to deal with all three tiers of healthcare management mentioned above.[1]

The basic principles of HRGs are similar to DRGs. However, they differ on a number of points which include:

- HRGs were initially based on ICD-9 (and more recently on ICD-10) diagnosis codes and Office of Population Censuses and Surveys, Version 4 (OPCS-4) procedure codes. Cross mapping Read codes to ICD and OPCS codes has enabled the use of Read as well.
- Length of stay was used as a proxy for resource consumption as costing details were not available.[25]
- In DRGs a case is allocated on the basis of the principal diagnosis into a MDC, and then to a final DRG on the basis of the procedure (if a procedure was carried out) or on the basis of the diagnosis.[8] This has the effect of enabling the grouping for the same procedure into different MDCs (and DRGs) if the principal diagnosis is different. In HRGs the case is allocated directly to an HRG if a significant procedure was undertaken (see Fig. 8).

The first version of HRGs diverged from DRGs by including physician costs, incorporating specialty codes and prioritising diagnoses over surgical procedures in most algorithms.[12] The predictive value of these DRGs was found to be poor and they were revised back towards DRGs in Version 2 which:

- Dropped the use of specialty codes.
- Gave higher priority to surgical procedures and used a defined procedure hierarchy to determine the main procedure, rather than the order in which multiple procedures were coded.

- Placed a greater emphasis on patient age.
- Included psychiatry.
- Revised groups as a result of more detailed statistical analyses to determine optimal group divisions.

HRGs Version 3 has 565 HRGs divided into 18 MDCs.[10]

APPENDIX III

EXAMPLE OF A CASEMIX LISTING

Extract from Australian National DRGs (AN-DRG), Version 1[25]

Pre-DRG Group Listing
1 *Surgical* Mouth,larynx,pharynx dis w tracheostomy age > 15
4 *Surgical* Tracheostomy oth than for mouth,larynx,pharynx dis age > 16
5 *Surgical* Liver transplant
6 *Surgical* Bone marrow transplant

Circulatory System Group
239 *Surgical* Vein ligation & stripping
240 *Surgical* Other circ system OR procedures
241 *Surgical* Implant or replace of AICD,total system
242 *Surgical* Implant or replace of AICD leads
243 *Surgical* Implant or replace of AICD,generator
244 *Medical* Circ dis w MI & invasive invest proc,died
245 *Medical* Circ dis w MI & invasive invest proc w CC
250 *Medical* Circ dis exc MI w invasive cardiac proc
251 *Medical* Infective endocarditis
257 *Medical* Hypertension w CC
258 *Medical* Hypertension w/o CC

GI System Group
308 *Surgical* Stomach,eso & duod proc age > 9 w major CC
317 *Surgical* Appendicectomy w/o compl diag
329 *Medical* Eso'gitis,gastroenteritis & misc dis age > 9 w CC

Pregnancy Group
670 *Surgical* Cesarean section w/o compl diag w CC
671 *Surgical* Cesarean section w/o compl diag w/o CC
678 *Medical* Post-partum & post abortion diag w/o OR proc
684 *Medical* Preterm labor

Neonates Group
700 *Surgical* Neonate,died/trans<5 days of birth,born here w sig OR proc
701 *Medical* Neonate,died/trans<5 days of birth,born here w/o sig OR proc
704 *Medical* Neonate,died4 days of birth
705 *Medical* Neonate,adm wt<750g
706 *Medical* Neonate,adm wt 750-999g
707 *Surgical* Neonate,adm wt 1000-1499g w sig OR proc
711 *Medical* Neonate,adm wt 1500-1999g w/o sig OR proc w mult maj prob
715 *Surgical* Neonate,adm wt 2000-2499g w sig OR proc w mult maj prob
724 *Medical* Neonate,adm wt>2499g w/o sig OR proc w mult maj prob

Infection Group
800 *Medical* HIV w specified related condition age < 10
801 *Medical* HIV related CNS disease age > 9
807 *Surgical* OR proc for infectious & parasitic dis
808 *Medical* Septicemia age > 9
810 *Medical* Postop & posttrauma infection
811 *Medical* PUO age > 9 w CC
816 *Medical* Other infectious & parasitic disease diag w CC

Psych Group
830 *Surgical* OR proc w principal diagnosis of mental illness
831 *Medical* Acute adj reaction & dis of psychosocial dysfunction
835 *Medical* Organic disturbances & mental retardation
837 *Medical* Childhood mental disorders
838 *Medical* Other mental disorder diagnoses
Substance Abuse Group
851 *Medical* Opiod abuse or dependence
855 *Medical* Alcohol abuse or dependence
Injury/Poisoning Group
872 *Surgical* Craniotomy for mult signif trauma
882 *Medical* Injuries to unspec or mult sites age > 9 w major CC
890 *Medical* Poisoning & toxic effects of drugs age < 10
891 *Medical* Complications of treatment

Burns Group
910 *Medical* Burns,transferred to acute facility
911 *Surgical* Extensive burns w OR proc
914 *Surgical* Nonextensive burn w wound debr & other OR proc

Other/Ungroupable Group
950 *Surgical* Extensive OR proc unrelated to prin diag
951 *Medical* Principal diagnosis invalid as discharge diagnosis
952 *Medical* Ungroupable
953 *Surgical* Prostatic OR proc unrelated to prin diag
954 *Surgical* Non-extensive OR proc unrelated to prin diag

GLOSSARY

Ambulatory patient
A person who is not admitted as an inpatient to hospital. Some countries include same-day patients in this category. Generally synonymous with primary care patient (see below).

Acute inpatient
An inpatient whose illness is acute, and has one or more problems which require short-term healthcare in an inpatient setting, i.e. an acute stay hospital vs. chronic stay hospital, step-down facility, nursing home, etc.

ALOS
Average Length of Stay, i.e. the average number of days of stay in hospital for a group of patients.

AN-DRGs
Australian National Diagnosis Related Groups. A variant of the DRG system designed specifically for use in Australia.

AP-DRGs
All Patient DRGs. These were developed from Medicare DRGs (see DRGs) for the New York State Department of Health as a prospective payment system for all patients in New York State and include mechanisms to take into consideration severity.

APGs
Ambulatory Patient Groups. These have been developed for the US government for use as a prospective payment system in the ambulatory environment.

APR-DRGs
All Patient Refined DRGs. These were developed from AP-DRGs (see above) and are proprietary to 3M Health Information Systems. They were designed to specifically address issues of severity of illness, risk of mortality and resource intensity.

AVGs
Ambulatory visit groups. A precursor of APGs (see above).

Casemix
Casemix, at its most basic, is the mix of cases presenting to a health system, i.e. the range and type of patients a hospital or health service treats.

Casemix is also used as a generic term to describe scientifically developed grouping mechanisms used to categorise hospital or health service patient treatment episodes (i.e. the outputs or products of these systems) in order to facilitate scientific planning and management of healthcare. The basic principles underlying the development of any such groupings are that they should be:

- Clinically meaningful.
- Resource homogeneous.
- Limited to a manageable number of groups.
- Derived from routinely collected data.

Casemix grouping or groups
A generic term used to describe any scientifically developed grouping mechanism which:

- Is used to categorise patient care episodes.
- Adheres to basic Casemix principles (see Casemix above).
- Is defined by a specific allocation logic, set of codes and descriptions.

Casemix Groupers
These are computerised grouping tools which automate the assignment of a Casemix category to a patient care episode. These may be developed *ab initio* or may be modifications of others. Such modifications usually follow one of two approaches, i.e.:

- **Mapped groupers.** In mapped groupers the local diagnostic and/or procedure codes are mapped to their ICD-9-CM equivalents and the results are run through the original grouper.
- **Native groupers.** In native groupers, the local or 'native' diagnosis and/or procedure codes are substituted for the ICD-9-CM codes in the DRG definitions.

Casemix tool
A specific set of Casemix groups, codes and descriptions, e.g. DRGs, HRGs, etc., that may or may not have been incorporated into a grouper.

Casemix management
The use of Casemix tools for management purposes.

CCs
Abbreviation for Complications and Comorbidities (see Diagnosis below).

Clinical audit/review
A multidisciplinary healthcare quality assurance process which reviews clinical programs, their approaches and/or outcomes in order to continually improve 'best practice'.

Clinical grouping
Synonymous with Casemix grouping (see above).

Clinical guidelines and protocols
Guides developed by doctors for doctors delineating current best practice in the diagnosis and treatment of specific health problems. Cost effectiveness is usually one of the prime factors in their development.

Cost weight
In general, the cost of one item of production relative to other items (see weighting below).

Diagnosis
Is the description or categorisation of an individual's healthcare problem. Diagnoses can be categorised as:

- **Principal diagnosis,** i.e. The current, main reason for seeking healthcare services.
- **Complications,** i.e. healthcare problems that did not exist prior to the onset of the principal healthcare problem and are usually associated with or a result of the principal diagnosis.
- **Comorbidities,** i.e. healthcare problems that existed prior to the onset of the principal healthcare problem and coexist with but are not necessarily associated, with the principal diagnosis.

Complications and Comorbidities are often abbreviated to ‘CCs’.

Discharge status
A means of categorising patients when leaving a healthcare facility, e.g. discharged home, discharged to a convalescent facility, transferred to another hospital, died, etc.

DRGs
Diagnosis Related Groups. A tool developed in the USA for Casemix grouping of Medicare acute inpatient care episodes. The grouping is determined by principal diagnosis, CCs (coded using ICD-9-CM diagnosis codes), surgical procedures, if any (coded using ICD-9-CM procedure codes), and occasionally gender, age and discharge status of the patient.

Episode
A healthcare episode is the period from when an individual develops a health problem until that problem is resolved.

Encounter
A single interaction with a healthcare provider.

Fee-for-service
A method of reimbursement in which healthcare providers receive payment for each unit of service provided.

Fixed fee
An all-inclusive fee, usually used in the remuneration of hospitals, either per procedure, day or Casemix group.

Grouper
See Casemix grouper.

HBGs
Health Benefit Groups. These are being developed by the NCMO (see HRGs below) of the NHS to categorise the population in terms of its need for healthcare and, given appropriate care, its ability to benefit.

HCFA
The Healthcare Financing Administration of the US Federal Government.

HRGs
Healthcare Resource Groups. These were developed by the National Casemix Office (NCMO) of the UK National Health Service (NHS) as a unique set of Casemix groups (see above) for inpatient, day case, outpatient and community-based services. These were developed as modified DRGs (see above) were found to be problematic in the UK.

ICD
The International Statistical Classification of Diseases and Related Health Problems. This is an international standard classification maintained by the World Health Organisation.

ICD-9
The Ninth Revision of ICD.

ICD-9-CM
ICD-9-CM is a USA modification (CM - clinical modification) of ICD-9 which is updated annually for the US Federal Government.

ICD-10
The 10th Revision of ICD.

Inpatient care episode
The period from when a patient is admitted to hospital as an inpatient until the patient is discharged.

LOS
Length of stay (see ALOS) in hospital.

Mapped groupers
See Casemix Groupers above.

Native groupers
See Casemix groupers above.

Nomenclatures
These are coding systems that are used in a process of **terming**, i.e. they are a unified attempt to code, at a detailed level, all aspects of the clinical process. These are essential for recording patient care in electronic medical records.

OPCS-4
Office of Population Censuses and Surveys, Version 4. The procedure coding system used in the UK National Health Service (NHS).

Outlier
Generally, an unusual case. In a Casemix context, an inpatient who stays in hospital much longer (day outlier) or costs much more (cost outlier) than the established average for the Casemix group to which the episode belongs.

Primary care
Refers to the point of first contact with the health system, i.e. clinics, outpatient departments, accident and emergency units, consulting rooms, community nurses, general practitioners, etc. Generally synonymous with ambulatory patient (see above).

Primary healthcare
An approach to ensuring the sustainable delivery of affordable, equitable, quality healthcare to the community at large. The concept was first adopted by the WHO and UNICEF in 1978 following the Alma Ata conference. It is defined in the Declaration of Alma Ata as: *"Primary Health Care is essential health care based on practical, scientifically sound and socially acceptable methods and technology made universally accessible to individuals and families in the community through their full participation and at a cost that the community and the country can afford to maintain at every stage of their development in the spirit of self-reliance and self-determination".*

Procedures
Activities carried out to help resolve a healthcare problem. Procedures can be categorised as:

- **Cognitive,** e.g. consultations.
- **Investigative**, e.g. pathology, radiology, ECG, EEG, audiometry, etc.
- **Therapeutic**:
  - Surgical, e.g. operations.
  - Medical, e.g. radiotherapy.

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Principal diagnosis
The diagnosis or condition chiefly responsible for a patient encounter with a healthcare provider.

Read codes
A nomenclature (see above) developed for use in the UK National Health Service (NHS).

Resource weighting
See weighting below.

Utilisation Review (UR)
A formal review of patient utilisation (i.e. use of healthcare resources) or of the appropriateness of healthcare services.

Weighting
Within the context of Casemix, LOS and/or costing data per patient care episode is collected, outliers are removed and a simple average LOS or cost is calculated per Casemix category. When these LOS or cost averages are divided through by the average of all categories, a relative resource weighting is obtained.