Aus dem Universitätsklinikum Münster
DRG-Research-Group
Prof. Dr. med. Norbert Roeder

Determination of Risk Factors for High-Cost Cases within DRG Systems of Selected European Countries

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vorgelegt von Mohamed, Rosminah
aus Kota Bharu, Kelantan, Malaysia
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Aus dem Universitätsklinikum Münster
DRG-Research-Group
Referent: Prof. Dr. med. Norbert Roeder
Koreferent: Prof. Dr. med. Georg Gosheger

ABSTRACT

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Mohamed, Rosminah

Diagnostic Related Groups (DRGs) have provided a new aspect of financial tool to the health care systems in Europe. However, the EU countries have to address the challenges of cost variation within DRG to a different degree because only DRG systems with high levels of cost homogeinety can be used as prospective pricing systems.

The first study ojective is to identify the risk factor adopted in the German G-DRG system, the Dutch DBC system, the Swedish NordDRG system and the French-GHM system; secondly to compare the differences and similarities of the risk factors developed and chosen within each national DRG system and finally to analyse the dependency of the existing risk factors on the national health care structure. Consequences for the possibility of future cross-border EU DRG systems should be discussed. Systematic literature analysis is chosen to analyse the currently employed DRG systems and risk factors in four selected EU countries: Germany, Netherlands, Sweden and France.

There are substantial differences of current European national health care systems and risk factors used in the DRG systems. Distinguishable methodologies apply for the determination of the cost weights within the selected countries and may contribute to the variation of the derived risk factors. A common European DRG system is therefore far beyond to be realistic within the short or medium terms.

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Abbreviations

ADRG	Adjacent DRG (Basis-DRG)
ALOS	Average length of stay
APC	Ambulatory Payment Classification
AR-DRG	Australian Refined DRG
CC	Complication and Comorbidity
CCL	Complication and Comorbidity Level
CM	Case-Mix (sum of relative weights)
CMI	Case-Mix-Index (ratio of sum of relative weights [i.e.CM] and number of cases, represents mean of relative weight)
CPK	Center for Patient Classification
DBC	*Diagnosis Behandeling Combinatie*
DIMDI	The German Institute for Medical Documentation and Information
DRG	Diagnosis Related Group
EU	European Union
FP	*Fallpauschalen*
GDP	Gross domestic product
G-DRG	German Diagnosis Related Group, Deutsches DRG-System
GHM	*Groupes Homogenes de Malades*
HCFA	Health Care Financing Administration
HRG	Healthcare Resource Groups
ICD	Internationale Statistische Klassifikation der Krankheiten und verwandter Gesundheitsprobleme (10. Revision)
InEK	Institut für das Entgeltsystem im Krankenhaus gGmbH („DRG-Institut“ der Selbstverwaltungspartner)
KV	*Kassenärztliche Vereinigung*
LKF	*Leistungsorientierte Krankenanstaltenfinanzierung (output orientated hospital financing system*
LSO	Long-stay outliers
MCE	Medicare Code Editor
MDC	Major Diagnostic Category (Hauptdiagnosekategorie)
NCSP	Nomesco Classification of Surgical Procedures
NUB	Neue Untersuchungs- und Behandlungsmethoden (nach § 6 Abs. 2 KHEntgG)
OPS	Operationen- und Prozedurenschlüssel (nach § 301 SGB V), procedure classification
OR	Operating Room (-Prozedur)
PCCL	Patientenbezogene klinische Komplexitätsstufe (Patient Clinical Complexity Level)

PPS	Prospective payment system
RA	Risk adjustment
RG	Relativgewicht (see also Bewertungsrelation: BR)
SAPS	Simplified Acute Physiology Score
SHI	Statutory Health Insurance
SPRI	Swedish Institute for Health Services Development
TISS	Therapeutic Intervention Scoring System
US	United States

1 Background

Increase in health care expenditures both in the annual health budget and per capita can be observed in all EU countries. In order to control health care expenditures most EU governments introduced and use Diagnosis Related Group (DRG) systems. Controlling health care expenditures with the help of DRG-based reimbursement systems efficiency, solidarity (fairness and equity), high quality standards for the entire population and universal access to care can be maintained [16].

Every DRG system in active use is on a stage of continuous change. The main reasons for changes are due to the evolution in medical treatments and management of health care. The two most important criteria for changes are the same requirements of resource intensity within given DRG and similar type of patients in each DRG from a clinical perspectives. DRGs are either altered, added or removed, usually on yearly basis. Variations in costs will always be present, and hospitals should expect that some patients will cost more to treat than the payment rate. In practice, much depends on the efficiency of the episode classification. None of the classifications used for the payment of acute inpatient episodes is entirely satisfactory. The main problem relates to a small but significant proportion of cases, which costs are far exceeding the payment rates for the classes to which they belong. Therefore most payment systems based on DRGs use “rules” as a cost control mechanism for unusually costly patients (high outliers), where additional payments are made.

Allocation of resources is a paramount importance in health care organizations. An important aspect of this problem is allocating funds for very high cost patients. Understanding and predicting how this patient arises is a subject of continuing research [22]. Several articles evaluate the ability of diagnosis-based risk adjustment systems to predict high cost patients [22]. Risk adjustment (RA) systems have difficulty predicting the exact costs of these patients because they are rare and driven by relatively rare acute events. In DRG systems, these events are referred to high-cost DRGs represent patients whose defined

algorithm is above boundary point relative to patients treated for the same condition, who are known as high outlier cases. Patients who become high outliers are often reviewed to ensure that there is no system issue that is preventing them from leaving hospital. An episode defined to be an outlier because it involves use of resources which is far above the average for the class to which it belongs. Application of an appropriate RA model is believed able to achieve greater allocation and equitable funding for referral hospital. [41]

The mainstream of RA methodologies is a valid and useful tool to measure quality-improvement activities, affected by the confounding and modification produced by the medical care over risk variables' effect. Thus, criteria involving patient diagnostic, demographic, and medical characteristics are the most effective way to proceed. RA analysis is eventually of benefit for both, the hospital and the health insurance company. Whereby, the latter should receive a sufficient risk-adjusted payment (premium) from each consumer as it reflected the consumer's predicted health expenditure. And, the former should be reimbursed based on patient's health-risk adjustment charges. An appropriate RA must be context specific. Thus, the outcome generated model is proven worked well on the ground [6].

Several approaches have been taken by those countries employing DRG-based payment system to alleviate the difficulties caused by the high-cost cases. Splitting the case type into two or more parts according to clinical attributes (such as diagnoses or method of treatment) and then setting different payment rates for each is most commonly done [46, 53]. There are countries that make an approach to involve measurement of attributes which could contribute to high cost, such as severity of illness [1, 48, 53]. Another approach is using care pathways [26, 41, 42, 45]. Taking advantage from the subset of reasons why the patient deviated can be selected as the basis for making additional payments, which is equivalent to high outlier payments.

Ensuring equity of access to health services, rising quality, improving health outcomes, sustainable financing, improving efficiency, greater responsiveness,

reducing barriers between health and social care are among mission and vision of health care provision to the population. However, the response of these challenges differs as each country adopts the most appropriate approach anchored to its historical, political, social and cultural context. As regard to the health care system, EU Member States have several things in common; a mandatory health insurance system that possibly supported with government revenue, supplemented health insurance, risk bearing sickness funds, a guaranteed periodic consumer choice among sickness funds and a risk adjustment mechanism. The possibility for them to share a similar view towards encountering the high-cost cases present within the DRG system and apply the same risk factors, is currently vague and yet to rectify.

1.1 Incentives for using DRG systems

DRGs has a long-standing system of prospective payment system (PPS) due to their immanent potential to control health care cost, several social objectives such as improving overall health care quality reflected in a good health care delivery [39] feed into the DRG system.

1.1.1 DRG System and its employment

In broad terms, the economic goals of health systems include control over total cost, allocative efficiency and technical efficiency [57]. To achieve these goals, case mix systems are introduced and applied in several countries around the world as a cost containment strategy. It is used for hospital resource allocation planning, hospital management, and tracking care productivity and quality. Internationally, many countries adopted the original American model and modified it to meet country-specific needs. Based on the costs per weighted case resulted from the cost of patient's hospitalization in a specific condition and usually classified according to clinical diagnoses, the allocation of hospital resources is finely determined. University hospitals, as referral hospitals usually

receive higher allocation compared to other hospitals, judgmentally based on the more critical cases they receive.

Ever since, the manner of which the data collected and reimbursement rates calculated in hospital management systems differs substantially among the EU countries. Resource consumption is calculated based on average treatment costs in the particular group of DRGs. In order to obtain homogenous resource groups at the hospital level, DRG Classification System groups inpatient by principle diagnosis, co-morbidities, surgical procedures, discharge status age and sex. Usually, the cost differences within the same groups are compensated because the expensive cases are outweighed by those with lower-than-average costs. The presence of outlier cases within DRGs that incorporate with either very low or high costs can distort the calculation of the average costs per DRG. Whereby, the so-called “masking effect” will be happening due to under valued or over valued DRG that were not corrected accordingly [24]. This is the main challenge of this system, to classify treatment episode into both medically coherent and cost-homogenous group at the same time. Consequently, the average resource use for each group can be determined [36].

The force of payment and quality performance are starting to converge. Pay for performance is an emerging movement in health insurance (initially in Britain and United States). This is the first step towards changing the hospital payment system to one-based combination of diagnosis and treatment. Providers under this arrangement are rewarded for meeting pre-established targets for delivery of health care services. Pay for performance cannot consist of a one-size fit all approach. However, there should be common agreement on the overall conceptual approach together with a tool box of approved techniques from which payers, providers and consumers can choose to build the incentives needed to implement pay for performance. The variation in quality of care, variation in health care cost services underuse and overuse, the opportunities for cost reduction and quality improvement can be identified [18].

1.1.2 The Incentives

Many studies have examined the incentives of the DRG-based PPS on costs, operational matters, and on quality [11, 36, 17, 18]. It appears that the implementations has positively affected on patient's health quality, in certain ways hospital operated, increased the insurance market competition as a whole through a few incentives offered within the system and improve health care provision system at the national level. The mutual impact caused by the incentives offered by the DRG system is diagrammatically showed in Figure 1.1 below.

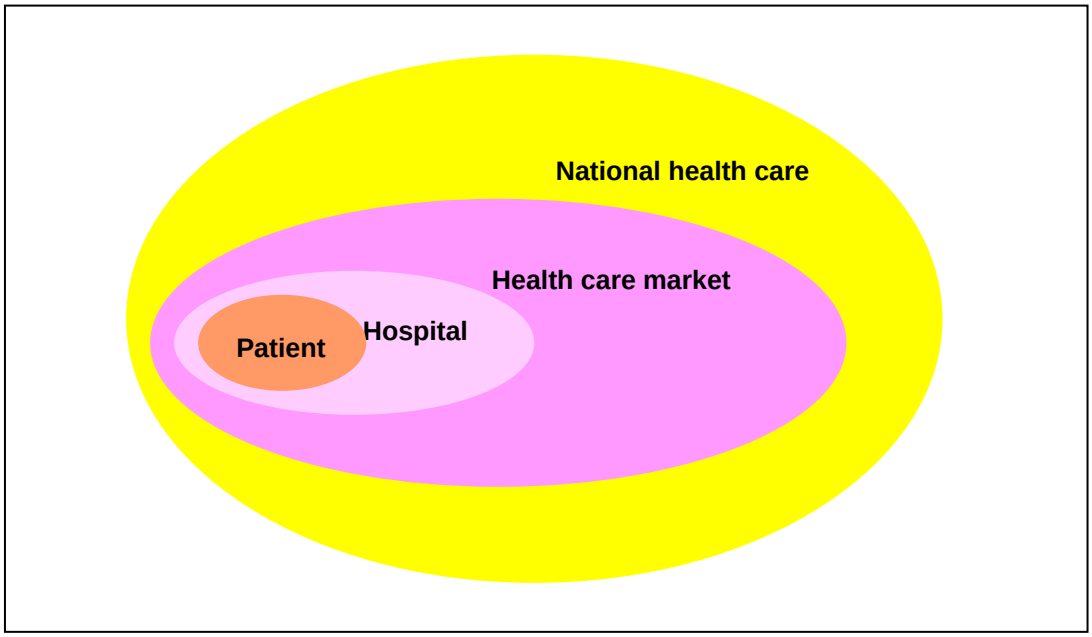

Figure 1.1: Inter-related impact of DRG incentive to the patient, hospital, health care market and the national health care system

There was evidence of decreased average length of stay (ALOS), admission and intensity of care, and thus health care costs. There are issues of DRG upcoding purposely to receive higher reimbursement. Measures are being developed in various countries to curb this phenomenon by creating reward

systems to motivate medically correct coding [54]. It may encourage more coding of complications (up-coding) if this leads to an upgrading in the severity of DRG, and therefore increased reimbursement. It may encourage more intensive treatment of patients if such treatment leads to an upgrading in the severity of DRG, and therefore increased reimbursement (but only if the increase in reimbursement exceeds the increased costs of treatment).

Within a treatment group, the payment mechanism gives a strong incentive to minimize costs, or to shift the costs of treatment onto other parties (such as the user or a social care agency). On their own, pure case payments offer no incentive to maintain quality of care (indeed there may be strong incentives for quality skimping). It encourages treatment of patients whose expected costs are lower than the associated reimbursement. This might be beneficial (if those patients will benefit from treatment) or adverse (if the benefits are questionable). Broad diagnosis groups give powerful incentives to efficiency, and minimize the scope for data manipulation. However, they also give strong incentives for cream-skimming lower cost patients and to skimp on some aspects of quality. Other incentive is DRGs create a financial incentive for hospital to avoid high-dependency patients, whose expected costs are higher than the associated reimbursement.

The financing of health care services under DRG assignment is a prospective manner. Compared to retrospective payment system (hospitals were reimbursed in full for costs expended in service provision), the PPS introduced pre-determined reimbursement rates for service packages determined based on DRGs. The PPS can foresee the health care services reimbursement is a relative and resource driven system. Hospitals within EU countries are using DRGs as instrument for hospital reimbursement and receive fixed payment (reimbursement) from sickness fund based on DRGs calculation. Sickness funds have a budgeting system in which they negotiate the quality, quantity and, to some extent, price of services with providers. This gives the funds some flexibility and incentives to purchase care as effectively as possible, and to encourage market competition. Additional provisions were made of quality

assurance to provide medical stability upon discharge such that hospitals were not "dumping" the patients to maximize the reimbursement system. These internal mechanics of quality assurance were monitored by state and federal guidelines

1.2 Characteristics of DRG Systems

1.2.1 The DRG System

The DRG system is used to describe the patient case-mix in hospital care. In the late 1970s Professor Robert Fetter of Yale University developed the concept of DRG to simplify the complexity of patient specific diagnoses, by grouping similar diagnostic categories into clinically meaningful diagnostic clusters, where resource use was also similar. There are three rules for a competent DRG system: each DRG must be clinically meaningful in a way that the diagnostic clusters must be acceptable by clinicians; each DRG must be resource homogeneous in such a way that the type of resources used and their amount, should on average be the same for each episode of care within the DRGs, and lastly the specific diagnostic episodes should "map" to that DRG alone, and not to multiple possible DRGs. The basic idea was to describe hospital activity by focusing on the total hospital spell as the final product, measured as discharges defined according to the patient‘s diagnosis (described according to the International Classification of Diseases, or ICD-codes), and reflecting resources used.

The DRG system was first applied in the United States (US) in 1983 as basis for the PPS introduced in Medicare (is often termed as HCFA-DRG system, after the Health Care Financing Administration who was responsible for its implementation). Since then, a number of countries have implemented DRG systems in hospital care (Figure 1.2). Currently, DRG systems capture mainly inpatient care activities although some countries have developed DRGs also for outpatient care (e.g. day surgery). Yale University developed DRGs in the early

1970s, mainly to describe all types of patient care in an acute care hospital in response to the rising costs of health care. Initially, the focus was on the identification and explanation of the differences in performance and in the treatment quality. However, soon they recognized the potential for cost containment. In 1983, the system initially encompassed the Medicare program of the US as part of a PPS for hospital spending, involved newborn, paediatric, and general adult populations.

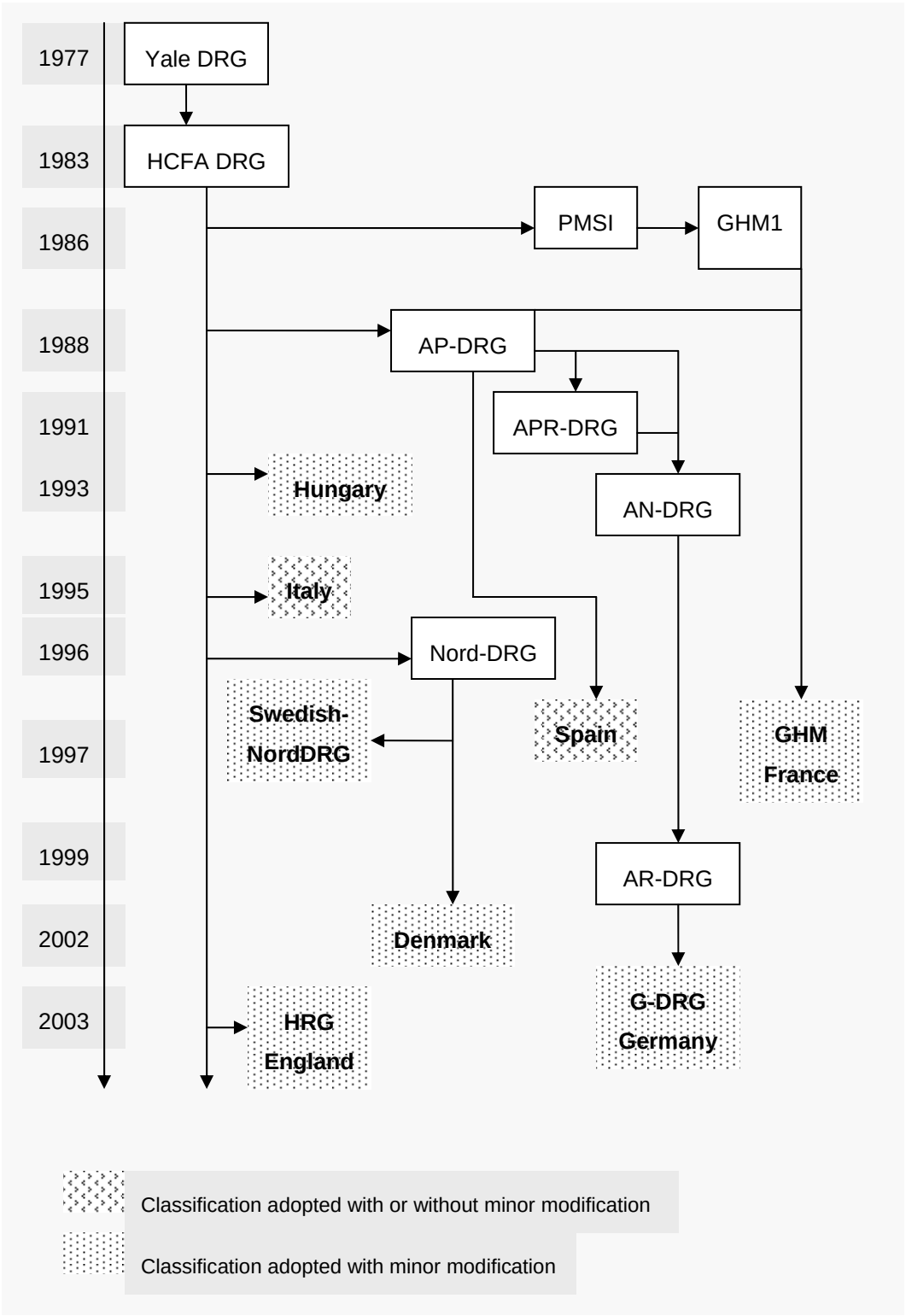

Figure 1.2: Categorization of patient classification

1.2.2 The DRG concept

Conceptually, the DRG system groups patients by means of specially designed software into a certain number of categories based on their main diagnosis, clinical procedure codes, gender, age, and the presence of complications and complexities, which those are also served as screening criteria. The grouping procedure starts out by categorising patients in Major Diagnostic Categories (MDCs) according to their main diagnosis. Subsequently, separation is made between medical and surgical cases. The resulting DRGs are assumed to be categorised in a way so that each group is homogenous with respect to clinical and economic resource requirements.

Hospitals are paid a predetermined amount of money for treating patients from a given DRG, regardless of the actual cost of care provided. The German DRG variant seeks to classify hospital patients into over 1.000 groups or categories, using the diagnoses and procedures assigned to patients. Consequently, each DRG describes the service provided by the hospital by grouping together patient episodes (that are clinically similar) and use similar levels of resources.

1.2.3 The DRG framework and case costing

The framework of DRGs is hierarchical and MDCs represent the body systems built with a specific medical specialty. In Germany, the DRG system consists of 23 MDCs. The next level in the hierarchy divides each MDC into surgical, medical and “other” partition. The third level then assigns surgical patients into a DRG based on diagnosis and procedures performed and medical patients into a DRG based on the principal diagnosis and secondary diagnosis for which the patient was admitted.

The underlying coding system for diagnosis in use is the ICD-classification. Responsible for DRG assignment are the principal diagnosis, secondary diagnosis, operating room procedures, or a diagnosis-procedure combination.

In some circumstances patient's age, gender, type of discharge or length of stay may also influence the DRG grouping.

The DRG method assigns a numeric value to an acute care inpatient hospital episode of care, which serves as a relative weighting factor intended to represent the resource intensity of the clinical group in hospital care that is classified into the specific DRG. The DRG system allows only one DRG assignment per patient episode, so payment includes all services that occur between hospital admission and discharge. Grouping patients in this manner allows hospitals to evaluate and manage costs by DRG or groups of DRGs. Hospitals can also benchmark by groups for quality and resource measurement. Although hospitals assign cases to DRGs for internal use, the DRG used for payment is calculated as part of the claims processing. There are a series of steps in calculating the total DRG payment.

Unlike the traditional per diem costs that daily rates are established for specific hospital departments and represent the average cost of hospitalization in specific departments, costs per weighted case capture the cost of hospitalization of a patient in a specific condition and are usually classified according to clinical diagnoses.

Case mix complexity refers to an interrelated but distinct set of patient attributes to, such as severity of illness, risk of mortality, prognosis, treatment difficulty, need for intervention and resource intensity. Severity of illness describes the extent of the physiologic decompensation or organ system loss of function. The risk of mortality indicates the patient's likelihood of dying. The systems are differentiated by trajectory of development, clinical logic, severity classification structure, and level of complexity.

1.2.4 DRG systems and its differences

Over time DRG technology has evolved rapidly, to support the need for quality health care projects and facilitate the implementation and use of critical pathways, to include changes in health care delivery and advances in medicine. It also serves hospital needs for data management, reimbursement and comparability, benchmarking, and other types of research. Hence, few improved DRG versions such as AP-DRG, AR-DRG, APS-DRG and more, were developed within US Medicare system with distinguished taxonomy to evaluate acute care in hospitals and consider the factors that affect the cost of delivering inpatient health services. As a reimbursement system the DRG assignment determines the payment level the hospital will receive.

DRG variants currently apply in EU countries have diverged over the past two decades. The rapid changes and refinement done on the system resulted to the differences in the medical preferences on DRGs and in their cost accounting methodology in use. Therefore, considerable differences in the used DRG systems exist and make it difficult to achieve a common market in health care within the EU. Some European countries have developed own variants of DRG systems including the Scandinavian countries (Nord-DRG), France (*Groupes Homognes de Malades, GHM*), Germany (G-DRG), Netherlands (*Diagnosis Behandeling Combinatie, DBC*), Austria (*Leistungsorientierte Krankenanstalten-finanzierung, LKF*) and the United Kingdom (Healthcare Resource Groups, HRG). And many have been adopted by other countries, mostly as a basis of their hospital reimbursement system.

Australian Refined (AR-DRG) and American Health Care Financing Administration (HCFA) DRG systems are widely adopted as a basis of newly develop DRG by many countries. Obviously significant criteria within the system make it distinguishable. Upon many reason that make the AR-DRG system different, is the adjacent DRG comprises DRGs with different levels of resource consumption and are split on the basis of Patient Clinical Complexity Level (PCCL), age, malignancy, same day status, mental health status and mode of

separation. The Australian Case mix system uses the Complexity and Comorbidity level (CCL) to estimate the utilization of resources for treating complexities and complications. This level does not only depend on the severity of the complication, but it is also related to the discharge status and the adjacent DRG-group. While the CCL estimates the utilization of resources for each complication, the PCCL estimates the utilization of resources for all the complications and comorbidities of a patient. The PCCL is defined as “a measure of the cumulative effect of a patient's CCs and is calculated via a complex algorithm. AR-DRG system has been adopted by Germany as a basis for German DRG (G-DRG) system.

While the Australian system takes into account the cumulative effect of a patient's CCs, the HCFA considers only if there is a complication or not and does not categorize them in different levels. Patients in the US system are assigned to one of the 25 MDCs, based on their primary diagnosis. To express the differences in the consumption of hospital resources between surgical patients and patients with medicinal treatment, a subdivision is made. Surgical patients are classified according to the surgical procedure, while medicinal patients are classified according to their main diagnosis. The final assignment of a patient to a DRG in the US depends on factors such as the age of the patient, their discharge status and the occurrences of CCs. Among countries adopted HCFA DRG system is France GHM and NordDRG systems.

The Netherlands stands alone in its development of the DBC case mix system which are defined as the whole set of activities and interventions associated with a treatment received in hospitals, outpatient care and/or day care. DBC system is very complex and different in many ways. Among the differences presented by the DBC hospital reimbursement system is, the system is activity-based description instead of patient classification (which is the case with DRGs). The DBC relies on an episode-based registration within hospital. Detail of the system is discussed in Section 4.2.2 below.

NordDRG assignment process is originally developed from the HCFA DRG system. But, somehow it contrast where in NordDRG the decision process is combined to one table, DRGLOGIC. In this table all decision nodes are represented as variables. Currently 16 variables are actively used. Each non-empty cell is a rule that is tested in the decision process. The process is also described as a traditional graphical decision tree. The content of the decision nodes is derived mainly from the other tables in the NordDRG system. The complexity of the table is a reflection of the detailed nature of the original assignment rules. In contrast to the DRGs Definitions Manual endorsed by HCFA, the DRGLOGIC table describes the whole grouping process including the essential rules originally contained in the Medicare Code Editor (MCE). The rows in the table follow the hierarchy of the original assignment rules. Therefore, when allocating patient cases, each row has to be checked in ascending order until a match is found. The system has been used to group Finnish and Swedish outpatient observations with cost data.

1.3 Limitations of DRG Systems

Although DRGs have been widely used, the introduction of a DRG-system has always been beset with some criticism. One of the major problems is that the DRG-system may introduce sort of financial selection if it is applied as a basis for a financing system. Connected with this concern, there may be doubts regarding the medical and economical homogeneity of a DRG classification. The implication is possibly for several hospitals will have some DRG in which their patients are always more severely ill than in other hospitals. Another implication might be that a patient could receive poorer quality of care to reduce costs or that costs might be shifted to outpatient institutions.

Further point of criticism is that the DRG system stands or falls by the reliability and validity of the correct coding of diagnosis and procedures. The argument is, it might be tempting to place patients unjustly in expensive DRGs, the so-called DRG creep [41]. DRGs may be having a problem in price setting, which can

require a significant high charge claims data if the base is determined before utilization has been aggregately managed.

There were evidence of decreased ALOS, admission and intensity of care, and thus health care costs. However the quality of care is tend to diminish as the patient need for readmission due to fast discharged and poor quality of care. The DRG system also discourages treatment of patients whose expected costs are higher than the associated reimbursement (so-called “dumping” of high-dependency patients). Thus, threatening equity in access to health system.

With the German DRG introduction the hospital prices within a federal state were adapted within the scope of a several years' adaptation period (convergence period). The adaptation of the DRG lump sum payment system to the complexity of the provided services was relatively successful. However, not yet adequately represented within the G-DRG system are cases with extreme costs. The problem is that the medical complexity and the associated costs of those cases has yet identified appropriately, i.e. patients who need several major interventions or are treated for longer periods on the intensive care unit during their stay in hospital.

Although most health care provision under hospital inpatient care has assigned DRG reimbursement payment system, there are however, certain types of specialty hospitals and units were excluded from PPS because the PPS diagnosis related groups do not accurately account for the resource costs for the types of patients treated in those facilities. Facilities originally excluded from PPS included rehabilitation, psychiatric, children's, cancer, and long term care hospitals, rehabilitation and psychiatric hospital distinct part units.

2 Methodology

2.1 Study Objective

To identify the risk factor adopted in German DRG system, Netherlands DBC system, Swedish-NordDRG system and France GHM system. The different and similarity of the risk factors selected from each country is comparatively reviewed for further objective to observe the reliability between risk factor determination with its dependency on the national health care structure in each respective country. Finally, an appropriate strategy of risk factor determination for European DRG systems is proposed.

2.2 Selection for Analysis

2.2.1 The research proxy

Four EU countries were randomly selected, generally based on their health care delivery system and the cost accounting system in use. These countries become a proxy for other EU Member States that possesses similar characteristics. The countries are Germany, Sweden, France and Netherlands. Sweden, amongst Scandinavian countries, presents a decentralized system of health care funding and employing the NordDRG system as hospital reimbursement system. Whereby Germany and the Netherlands provide examples of social health insurance system combined with private health insurance for high-income earners and self-employed persons. G-DRG and DBC are currently implemented in Germany and Netherlands, respectively. France, is comfortable with their GHM (*Groupes Homogènes de Maladise*) hospital reimbursement system illustrating a more centralized model of social health insurance, offering universal health coverage, a mixture of public private non-profit and for-profit providers.

2.2.2 Concept and scope of study

The study conceptual is based on systematic review of the literature, which generally compile information and further investigate significant risk factors foiled around DRG system in each proxy country. And, the significance of its presence within the respective national health care system will be discussed. This top-down approach will generate a general conclusion, to serve as fundamental information for an adequate and reliable future risk factor in risk-adjusting the high-cost variance within the DRG system.

The scope of study involves a cross-national review on the structure of the health care and financing system. Extensive review on DRG systems in each respective country will lead to an identification of the risk factors in use. Investigation encompassed the general principle of DRG cost accounting will be done to reveal the variation of the risk factors with respect to the DRG system currently employed in each proxy country. The integration of knowledge gained from the above and the dependency of each country's national health care structure with respect to the determined risk factor will lead to a discussion on the issues. And further, stimulate research objective for conclusion and proposal to be withdrawn. A complete methodological flow is illustrated in Figure 2.1.

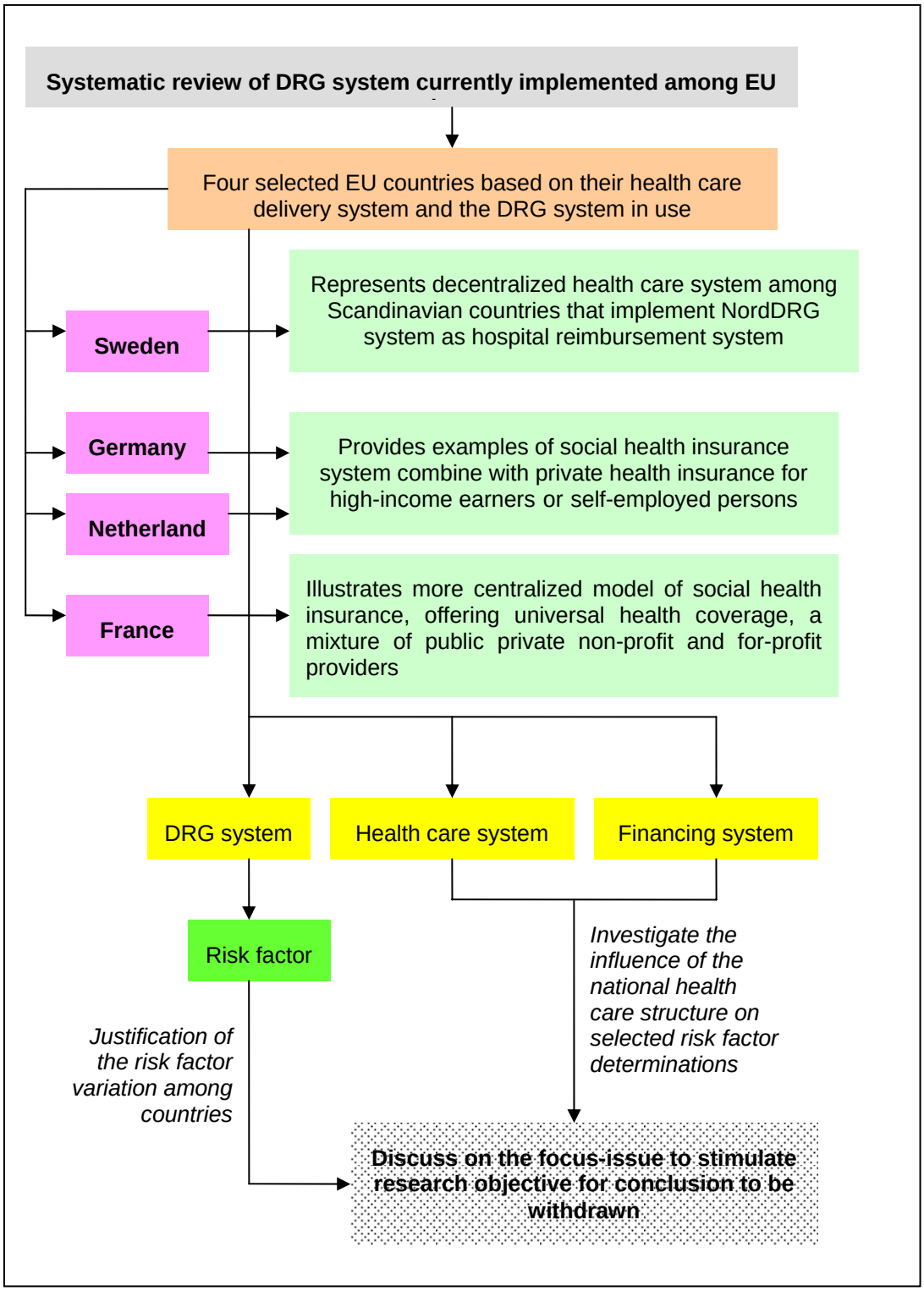

Figure 2.1: Research methodology: the systematic literature review approach

2.2.3 Data resource

The DRG System Classification Manual and Handbook from each proxy country are the main sources for the respective country's DRG system input data and information. Various internet data sources and academic scientific research searches with real-world policy experience will certainly advantageous for high-cost DRGs variation related information and other factor contribute to the current issues were as well reviewed.

Definition of terms related to current study is tabulated below.

Term	Definition
Risk factor	A risk factor is a variable associated with high DRG costs and create high-costs variance within DRG assignment.
Risk adjustment	Mechanism to compensate for differences among patients that may affect their health care outcomes. It is a way to level the unfairness in hospital reimbursement by statically accounting for illness, demographic and other factors that patients bring into a healthcare encounter.
Outlier	An outlier is a case with costs which are significantly different from the average for the payment class to which it belongs.
High-cost cases	Refer to cases in which algorithm is above boundary point relative to the patient treated for the same condition per episodes of care
High-cost variance	High cost difference resulted from high-costs DRGs within DRG system

Table 2.1: The related study terms and definitions

2.3 Review of literature

Worldwide, in the hospital sector, a dramatically increase of costs is observed. Therefore governments try by several means to gain control of the situation. The main goal is to control costs. There are several components that contribute to the rising costs in the health care delivery systems. Demographic changes, costly medical innovation recently boost in the health care market and demand for higher quality care expected to be seen in health care market that leads to an increase of cost treatment [2].

High utilization of health care services by high-cost patients such as patients with chronic kidney disease [15], patients with thrombosis [34] and neoplasm of the head and neck [38] markedly demand for increasing health care resources to be considered. In year 2004, diseases of circulatory system is reported attributed the highest cost of illness (€ 35,270 million) in Germany that involved both gender male and female [18]. Yung *et al* found that elderly adult patients (higher than 65 years old) predicted higher costs (compared to the young one) because they normally have chronic illnesses treated with drugs and therefore incurred more costs on them. The extremely high cost of ICU care documented that many patients admitted to ICU died regardless of the quality of care they received [25]. This is appropriately determined that the high proportion of total expenditure occurs at the end of life [12], where patients usually diagnosed with multiple complications and yet, unwell differentiated by the DRG classification. In this circumstance, majority of instances payers did not compensate adequately for severity, and higher values for the severity variables therefore resulted in financial losses for the hospital.

Experience from Australia and other countries indicate that a fair reimbursement for intensive care based on the existing DRG systems is not realistic [34, 6, 7]. Hospitals with a high proportion of intensive care are systematically underfunded, because they are the sicker and more expensive patients within one DRG [34]. Onnen Moerer in his study on the cost of intensive care units (ICU) concluded, that the mean total costs per day were €791 ± 305 (primary

care hospitals, €685 ± 234; general care hospitals, €672 ± 199; focused care hospitals, €816 ± 363; maximal care hospitals, €923 ± 306), with the highest cost in severe septic patients (€1,090 ± 422). Specialized and maximal care hospitals treat a higher proportion of the more severely ill and highly expensive patients; similar to the new G-DRG-based reimbursement system in German hospitals carry risk that intensive care will not be adequately reimbursed [25].

A fair hospital payment is greatly expected from this prospective reimbursement scheme. However, fairness hospital payment is apparently not always achieved. This is due to the discrepancies along the spectrum of health care treatment and services. The complexity even, can be seen across the same underlying disease diagnoses [20, 18, 56] averaging principle inherent in DRG case weights has resulted in some high-intensity DRG weights being too low for a teaching hospital that is a major referral service [2]. It is acknowledgeable, there are groups of illnesses that remain cannot be funded entirely on a flat rate fee system. Patient population at different settings may differ in terms of diagnoses, severity, and social support available. Treatment resources and protocols also may differ, and there can be similarities and differences in characteristics of patients treated, especially when the health provision come upon the high-cost DRGs that usually attach with them multiple stages of treatments and complexities. As a result, high-pay patients exist among patients diagnosed classify under the same DRGs. It is therefore, reflection of an imprecise cost calculation present in the system. According to Joost Z *et al*, based on the regression analysis, the larger budget hospitals have more chance to be underpaid as compared to smaller budget hospitals. This means that the former hospital receives more high-cost patients (than the latter hospital), which is associated to high-costs DRGs. Therefore, as regard to the public policy, Joost *et al* concluded that the new adopted DRG system must have a relation to the previous system in use. This can be done by introducing a recalculation on the case mix revenues, related to the former hospital budgets, as the scenario in Netherlands health care system. The over-funding patients usually contribute to a negative economic risk to the hospital as this high outlier cases are eventually distributed unevenly within hospitals. Indeed, it is crucial when it comes into

spending with scarce resources, particularly for inpatient care sector. Payment for complex cases is still too low, whereas cases with low severity are paid too high. This is disadvantage to university hospital and other large hospital [7] because the hospital received progressively less reimbursement relative to the costs over time due to the averaging principle inherent in the use of AR-DRG cost weights and the funding policy that all centers should be paid the same for the same AR-DRG episode [6, 7]. From the perspective of the large teaching hospital the pursuit of equity in addition to efficiency would involve the principle of a fair price that would cover the cost of the efficient provider plus allow 'normal profit'.

Joost *et al* in their studies in Netherlands on the DBC system found that differences in costs of intermediate products attributed to administration of costs within the general budget and cost centre structure, purchase and procurement agreements, surgical implant used, organisational and location structures. Economically, this kind of case will compromise with the hospital reimbursement funding system; if fewer amounts reimbursed, will impose financial burden to the hospital and contribute to a negative impact to the overall hospital quality of care due to the scarce resources. Or the hospital might go for "cream-skimming" as an option to avoid the financial burden. Hospitals or health care professionals who deal with high-cost cases usually shoulder the burden of the costs, which has historically exceeded reimbursement (total cost per patient per episode of care higher than the payment received) [15]. The literature thus suggests that DRGs can predict part of the variances in hospital costs, and may therefore be suitable as an instrument for output-pricing. Once again, in particular, the university hospital that usually incurred by the burden of teaching interns and residents, ordering extra tests and procedures for teaching purposes, and treatment of more serious cases [56].

In the health care reform that involves the change of the way hospitals are financed, case mix system is among the options selected to cover the hospital budgets. However, even though the average costs of the case mix can be

reimbursed, some hospitals may still face substantial financial and therefore, social risk.

Elements considered as risk factors vary across countries because the selection is relied on cost variance in the hospital cost data distribution and the cost weights of DRGs. Apparently, the outcome of these calculations vary and are influenced by a few factors such as differences in the definition of data samples, differences in the use of trimming methods to detect outlier cases and differences in the methods for calculating individual cost-weights [36]. There is also variation related to hospital ownership, implying that cost-weights may depend on the financing structure of the healthcare system as a whole. Finally, there is a variation in the type of cost components included in the cost base used to derive national cost-weights. Typically, LOS is used to determine the trim point due to it is easily manipulated as a basis for trimming. The long-stay outliers occur more frequently than short-stay outliers, implying that the average cost per DRG tends to exceed the median or typical case [35].

Magali P *et al* in their study highlighted that cost outliers are not always LOS or charges outliers. The proportion costs of costs outliers compared to the total costs of the sample was higher than the same proportion of the costs of LOS and charges. The use of LOS as an approximation of costs is thus only a stopgap. He suggested the use of diagnosis costs as an algorithm for trimming is necessary to envisage the progressive creation of a representative sample of hospitals, calculating the cost of the diagnoses they treat for both trimming and cost-weight estimation purposes. Apparently, this finding is supported by Antioch *et al*.

Antioch *et al* suggested using the diagnostic cost group or hierarchical condition category (DCG/HCC) classification system, involving patient relative risk scores to risk adjust the AR-DRGs, and better control for within-DRG severity. An alternative possibility would be to reimburse hospitals for the expected cost of individuals for a period of time (such as a year), rather than pay for an inpatient

episode as the unit of payment. This might be appropriate for patients requiring chronic care.

Comparing hospital performance that employ DRG payment system is going to be great advantage for improvement. However there is obstacle to achieve the right outcome. David M *et al* in their study of comparing the performance of two different hospitals by using indirect standardization of RA with data available from patient report card of fourteen Massachusetts hospitals concluded that this method of analyzing hospital performance is well justified for its specific case mix relative to the expected performance of an average provider for the same case mix. However, because of substantial differences in the distribution of risk factors, it may often be inappropriate to directly compare two hospitals using the results available in most public repost card.

The review on activity-based funding system by Gustaf *et al* mentioned that the activity-based financing shows that the health care becomes more bureaucratized due to costs escalation that apparently infringe the medical professional autonomy in providing care. However, the RA done on this financing system would bring the impact that could be explained by the political and functional pressure to change, in addition to its desired effects that brought with it undesirable economic impact.

To wrap-up this review, an argument for case mix payment to be acceptable, the average price and cost weights must be set at an appropriate standard. Other wise, inappropriate under-funding in the face of cost effective service provision can reduce distributional justice. If case mix policy is to maintain credibility, the funding arrangement must respond to changes in the cost structure of hospitals and meets increases in demand [2, 21].

It is highly important to know the country's DRG system and it is worthwhile to study the nature of the health institution (the health care and financing system) as it is a major element to understand why and how the DRGs have been implemented. Therefore, this study will begin by briefly looking at the facts of each DRG system for the selected countries' for better understanding.

3 Results

3.1 The German G-DRG-System

The German health care system is based on the principle of solidarity by self administration between hospitals and insurance companies (statutory health insurance, SHI).

German hospitals are financed on a dual basis which means that the health insurance schemes finance only the costs for the treatments, while the capital costs (e.g., investments in building, maintenance, major diagnostic equipment) must be financed by the bearer/government. The federal states support the hospitals by financing these investment costs.

The medical costs are covered by the health insurance. This comprises all costs for medically necessary diagnostics and therapy. The statutory health insurance (approximately. 200 SHI-funds) covers 90% of the populations. Total share for health care expenditure from the country's GDP in year 2006 was 245,003 million Euros (10.7%) [56].

3.1.1 Use in the Health Care System

Germany, like other industrialized countries in European region, has adopted a specific approach to the provision of health care services to the public. A single-tiered health care system being applied in Germany has shown the efficacy that relies upon the macro-regulation (macroeconomic health policy) by the Concerted Action in Health Care. This is a private consortium of insurers, providers and sickness funds representatives that operate in coordination with the government. The consortium serves as a national forum to determine the target used in fee or budget negotiations. In this respect Government has a limited involvement.The government adopts the role in regulation, describes compulsory health insurance and requires cross-subsidization.

Hospitals in Germany can be public, private or non-profit (mostly confessional). The physicians are either “ambulatory care” physicians or “hospital-based” specialist physicians.

Ambulatory care physicians may be general or specialist physicians. Most of them are organized in the so called *Kassenärztliche Vereinigung, KV* which entitles them to treat sickness fund patients. Patients are usually not restricted in the frequency or nature of their access to health care and they are free to select their ambulatory care physician and the hospital for health care services.

Health care costs are financed by insurance premiums, related contribution of employers and employees. Hospitals are financed on a dual basis: investments are planned by the governments of the 16 *Länder (states),* while sickness funds finance ongoing expenditures and maintenance costs. The risk-compensation scheme among sickness funds aims to level out differences in the age, sex and health status structure of those insured through the different schemes. This system has been complemented by the high-risk pool since 2001 and by incentives for disease-management programmes for the chronically ill since 2003 [57].

The German health care expenditure steeply rose every year [39]. Thus, encourage the policy maker to find an option to seduce the health care market for a better and financially fair for the population. As a result, a PPS was introduced for classifying hospital activity and be the base for the national hospital reimbursement system known as German Diagnosis Related Groupers (G-DRGs) System.

A defined and fundamental feature of G-DRG system for case-based reimbursement of inpatient services and curative care day cases was enacted under the reformed Hospital Financing Act, January 2000. And, it officially came into effect by the German legislation for inpatient health care sector on January 1, 2004, where the conversion of a flat-free model dominated the discussion between health care service providers and the health insurance companies. To ensure accurate and detailed updated informations reach to the provision of the

Hospital Financing Act, a self-governing body presented by the Federal Association of Sickness Funds, the Association of Private Health Insurance and the German Hospital Federation are mandated for this task and also ensure the continuity of G-DRG development.

Objectives of adopting DRG hospital reimbursement system in Germany are to have more transparency and fairer remuneration in hospital financing and to create incentives for economical and performance delivery by the system. It is also hoping to raise efficiency in the utilisation of resources in the hospitals, consequently promoting for hospitals efficiency as well as reduction of uneconomical capacities. In Germany, DRG system stands to form a basis for financing, budgeting and billing, as well as to assist in the development of strategies to regulate the access to care and equal treatment. Insofar, Germany is convenient with the adopted legislation as the G-DRG system, principally apply to all hospitals and the services are equally distributed to all patients regardless in which type of insurance coverage they are into or are self-paying patients.

G-DRG classification describes the activity of health care facilities, and principally applies to all hospitals and clinical departments with exception of institutions or facilities providing services in psychiatry, psychosomatic medicine or psychotherapy. Outpatient care is not covered by this system. Ambulatory care is, however, widely covered through a fee-for-service system that fixed fee per visit for outpatient follow-up, per procedure and for same day surgery. Hospital day case admissions and rehabilitation sessions were included in the inpatient care.

The G-DRGs divide hospital activities into 23 MDCs that relate to certain health areas such as disease and disorder of the nervous system, disease and disorder of the eye and so on. More than 1.100 DRG codes were prescribed with a specific economic value (cost weight). This patient classification system selectively assigns treatment cases to clinically define groups that are distinguished by comparable treatment cost.

After the voluntary introduction of DRG based funding in the year 2003 the G-DRG system (German Diagnosis Related Groups) has been in effect for funding services of German acute care hospitals since January 2004. A budget-neutral period in 2003 and 2004 has been followed by a four-year period of convergence starting from 2005 to 2009. In this period of convergence the hospital-individual budget were adjusted to a uniformly hospital-independent fee for service (DRG) system.

3.1.2 The System itself

An updated ICD-10-AM-based Australian AR-DRG version 4.1 formed the basis for the G-DRG-Version 1.0 justified by the reason that AR-DRG was of the most developed generation which represents complications and co morbidities and was associated with low royalties. A comprehensive adjustment of the G-DRG patient classification based on local need and condition unambiguously assigns treatment cases into clinically defined groups that are distinguished by comparable treatment costs. There are two major elements of reimbursement namely, *Zusatzentgelte* and DRG, which are developed in this payment system. *Zusatzentgelte* are co-payments, described in a catalogue of reimbursements for special procedures. *Zusatzentgelte* are paid in addition to lump sum payment (DRG). The patient episodes are selectively assigned by procedure that is based on grouping algorithms. Criteria obtain from the inpatient hospital discharge data set such as diagnoses, procedure, clinical severity, co-morbidity, age and other algorithms are favorable to make the DRG assignment more unambiguously presented. The ICD-10-GM diagnoses and the German OPS301 procedure codes were respectively used for the diagnoses and procedure classifications.

There are two bodies which are responsible for maintaining and updating the coding system with different capacity; The German Institute for Medical Documentation and Information (DIMDI) is officially responsible on documenting and updating ICD-10-GM and OPS. Whereby, Institute for Hospital

Reimbursement (InEK) is responsible for annually calculating the cost weights as part of the cost components in the hospital reimbursement system. Since 2009 the prices for all principles that are based on case mix are negotiated at the state (*Bundesländer*) level. InEK is responsible for annually calculating the cost weight. The InEK enquires cooperation from hospitals in Germany to forward their hospital-related structural data and case-related claims data on yearly basis (through the Data Collecting Center, which then hands the data to InEK), as the cost and claim data collected from the German hospitals are deemed for the institute to measure resource consumption. InEK has essentially kept the quality and the completeness of this German case fee system by paying attention to the accuracy and to the scope of the data calculation through two steps of plausibility checking at the Data Collecting Center and InEK itself prior determining the cost weights and trim points [51].

Further additional fees are used in the German DRG system, such as surcharges and deductions for outliers (length of stay not cost-outliers). The calculation of the supplementary fees is done by the InEK.

The basis classification and assignment of DRGs in the G-DRG system oriented on the sequence of DRGs hierarchically, within the MDCs partitions. Figure 3.1 illustrated the grouping process of G-DRG system, where data compilation in the “grouper” software will be assigned for a correct MDC to further determine the major diagnosis. Patients datasets will pass through the MDC categories prior to the selection of procedures at the MDC partitions. The determined procedure will then need to go through selection for adjacent DRGs; ADRGs). ADRGs consist of one or more DRGs, which basically consists of the same lists of diagnoses. But they differ in their consumption of resources and are based on different factors such as Patient clinical complexity level, secondary diagnoses, procedures, type of discharge, and/or age. As a result, a single DRG for each patient episode is generated unambiguously.

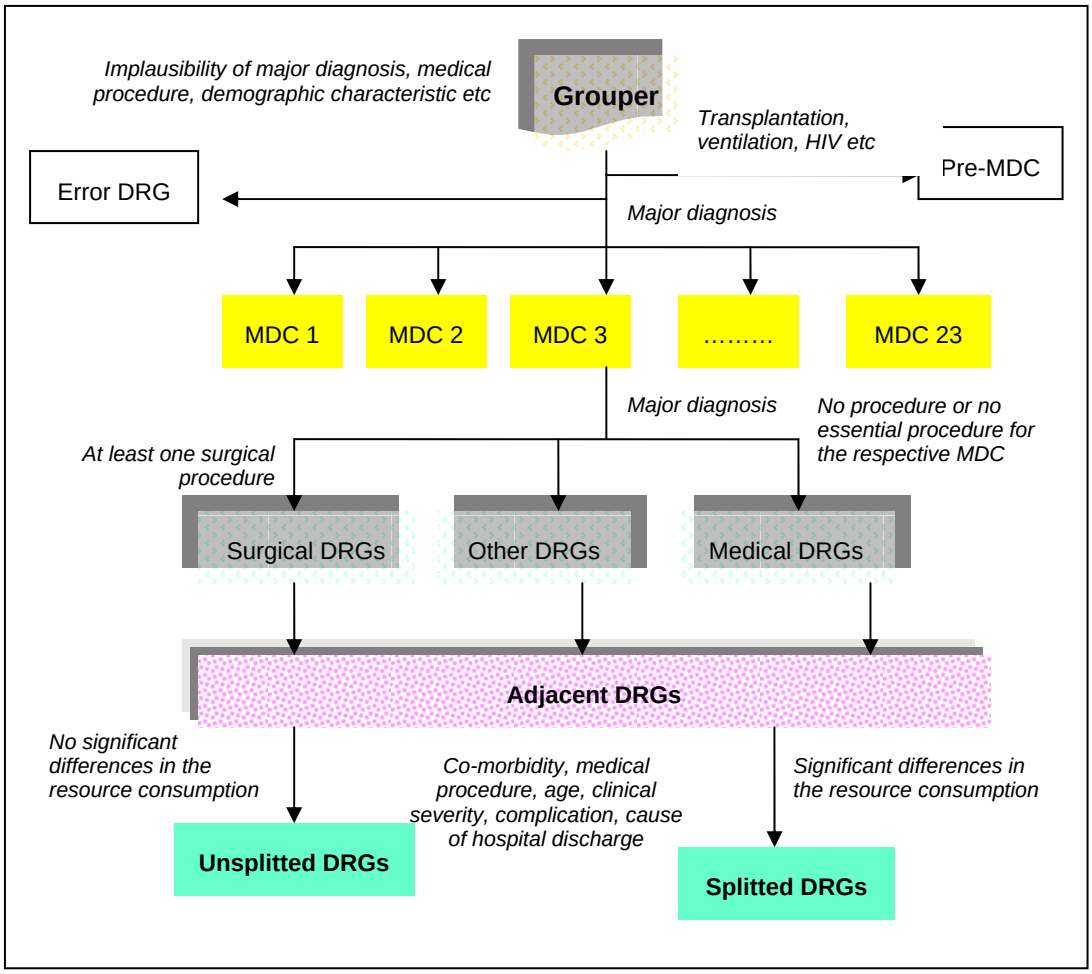

Figure 3.1: The hierarchical of the German DRG

In 2008 the G-DRG system consists of 1.137 DRGs and 115 additional charges (*Zusatzentgelte*). Important changes (codes, procedures, grouper algorithm, extreme cost DRGs, DRG for multiple procedures, quantity of DRGs, additional charges) were made by InEK every year and decided by the self-government in the health service. For the 2008 system, the InEK has begun with a moderate modification of the CCL matrix.

The DRG catalogue lists all DRGs with and without national uniform cost weights, and co-payments for certain complex or cost-intensive services, and/or for very expensive drugs. DRGs without national uniform cost weights are the result of insufficient data (may be due to the small sample size) for calculating the costs. Hospitals need to negotiate their individual prices for those

unweighted DRGs with the sickness funds. There are other surcharges in the reimbursement component that meant for new and innovative diagnostic and treatment procedures (example *Neue Untersuchungs und Behandlungs-methode, NUB*). The process for funding is through individual negotiation between a hospital and the sickness funds.

When calculating cost per case, all DRG-related costs are fully considered in order to obtain an optimal DRG costs weights. Outlier cases are excluded at this stage in order to have a medically coherent and cost homogenous group of DRGs. The average cost of inlier cases are determined for each DRG. The inliers cases are referred to cases that are treated within the standard LOS demarcated by a low and high LOS trim point.

Outlier cases are defined by crossing the lower or upper trim points of the standard LOS; respectively they refer to the short-stay and long-stay outliers. The minimum lower LOS trim point is two days or one third of the mean value of LOS, whilst the upper-LOS trim point is equal to the sum of the mean LOS and two standard deviations from the mean or calculated as the sum of the mean LOS and the preselected maximum value that is selected such way that the surcharges for long-stay outliers equal approximately 5-6% of the total amount to be reimbursed via DRGs [52]. The short-stay outliers (SSO) are subjected for per diem reduction, whereby the long-stay outliers (LSO) are reimbursed by per diem surcharges. The former case involves only cost differential of the respective DRGs (after deduction of non-primary costs from total costs of inliers) that further equally distributed among all treatment days below the lower-LOS trim point. Hence, an average cost per day is determined for respective DRG. Further dividing these average cost per day by the respective allocation base will finally generate a per diem cost weight, which is later used as a basis for deduction in the DRG catalogue. In contrast, surcharges for the latter cases (LSO) are calculated in three different ways, depending on the condition of the cost outlier distributions and other factors.

In the process of quantifying the hospital's average revenue per case, it involves the calculation of case mix index (CMI) or so-called average case weight of individual hospital, which is calculated by dividing the case mix (CM) by the total number of cases. This measurement reflectes the average utilization of health care resources of an individual hospital. From 2003 to 2009 (convergence phase) the hospital base rate is calculated by dividing a hospital's historically derived budget by the case mix. This calculation reflected the hospital's specific average DRG cost. Even though the hospital base rate among hospitals in Germany varies, somehow it gradually pushing to the principle goal of equalizing the rate to a state-wide base rate in 2009– same price for comparable hospital services throughout one state (*Bundesland*), independently of level of care, hospital structure or other factors.

3.1.3 Determination of Risk Factors within the System

Setting certain criterion on the selected factors is an attempt by InEK to improve the G-DRG mapping and consequently reduce the cost differences for establishing homogeneity within DRGs. A few elements have been considered for RA within the G-DRG system. As earlier mentioned in Section 4.1.2, case-based fixed-sum remuneration relates to treatment carried out within the framework of standard LOS. The LOS is calculated as the sum of the mean LOS and twice the standard deviation or maximum difference. The fixed maximum difference is chosen that the day-based revenue supplement for day-outliers beyond the LOS is accounted.

The DRGs differentiation is also taken into account the complexity changes in various alternatives and it is stimulated by using a standard set of splits for identified algorithms, such as PCCL (patient clinical complexity level), age, duration of ventilation used, mode of discharge and admission weight for neonate.

The G-DRG system uses the CCL (clinical complexity level) matrix or complex diagnosis (example osteomyelitis) to estimate the utilization of resources for the treatment of complications within the system. The PCCL is defined as “a measure of the cumulative effect of a patient's CCs”. The complication and comorbidity level (CCL) and patient clinical complexity level (PCCL) assigned within G-DRG assignment are valued respectively, for every diagnosis and separation, to measure the cumulative effect of complications and comorbidities. The PCCL split criteria into four levels of CCs, 1 to 4 presented the increasing state of patient’s severity. Changes for 2007 to 2008 involve a total of 19 new diagnoses included inside the CCL matrix by InEK.

Changes done by InEK could either be deletion or addition of the split criterion of procedures. The functions will have new grouping relevance, which could bring improvement to its function to become a more flexible split criterion.

“Complex treatments” modification was done, particularly on the use of the international therapeutic intervention scoring system (TISS) and the simplified acute physiology score II (SAPPS II) respectively, as grouping criteria in intensive care medicine. Significant clinical and laboratory chemical parameters of the patients, and specific chronic illnesses that make intensive care significantly more difficult an expensive such as malignant tumor as well as HIV/AIDS are covered by the above mentioned ICU scoring systems. However, HIV/AIDS is already classified under separate category in the MDC 18A HIV. Patient’s age and the admission status are amongst considerable risk adjusters, whereby these criteria are splitted into a few groups. Patients on intensive care units are scored daily. The sum of all scored points during the hospitalization is used for DRG allocation. High scores mark very complicated patients. However, the use of mechanical ventilation or artificial respiration is the primary criterion for ICU specific DRG allocation. The ventilation time is splitted into three breakdown parameters: minimum is >24 and maximum is >1799 hours. These classes are unique for the German DRG-variant.

In the case of a newborn infant with serious problems (DRG P02) in cardiothoracic or vascular interventions is replaced by a split based on length of artificial respiration. There were age splits introduced for determining pediatric treatments. Procedures such as radiotherapy, chemotherapy or radiotherapy are splitted based on the procedure list, for multiple interventions, criterion is split "in multiple locations" has been introduced.

Pertaining cases of newborn infant, admission weight has become the criterion element in the G-DRG system. The weight is differentiated on the basis of admission weight <999 grams prior to further splitted by admission weight <600 grams (P61A), 600–749 grams (P61C), 750–874 grams (P62A) and 875–999 grams (P62C).

3.2 The Dutch Diagnosis Behandeling Combinaties (DBC)

The Dutch health care system is a highly centralized system and was traditionally regulated by the central government. The specific health care providers are: GPs (for primary care), hospitals (for secondary and tertiary care) and nursing homes (for people who need nursing care, medical care or rehabilitation that cannot be offered at home). Major changes were done in 2006, when the system became more market-oriented and demand driven. The central government is shifting responsibilities towards the health care providers and health insurance organizations; more self-regulation based on market principles, which management is by two-tiered public-private system. This new system is a private health insurance with social conditions. The insurers are obliged to accept every resident in their area of activity. And the presence of risk equalization enables the acceptance obligation and prevents direct or indirect risk selection. The Health Insurance Act provides for an income-related contribution to be paid by the insured. Employers contribute by making a compulsory payment towards the income related insurance contribution of their employees. There are three compartments of the health insurance system available for three different coverages; the Exceptional Medical Expenses Act

(*Algemene Wet Bijzondere Ziektekosten, AWBZ*) for long-term care and high-cost services coverage, Sickness Fund Act (*Ziekenfondswet, ZFW*) for acute care coverage for public or privately insured patients, and the third compartment is a complementary insurance policy that may be bought to extend coverage. People who disqualify for compulsory health insurance due to certain reasons and are as well unacceptable to private health insurance (high risk patient) may enroll into Medical Insurance Access Act (*Wet op de toegang tot ziektekostenverzekeringen, WTZ*).

The Diagnosis Treatment Combinations - *Diagnosis Behandeling Combinaties* (DBC) system is nationally implemented, initiated by the interest of the Dutch government to develop a tool which gave essentially insight in the complete care pathway for each hospital patient. DBC is used for the registration, hospital reimbursement and medical specialist care. The main objectives of introducing DBC were to increase transparency of hospital and specialist care, to realize the transmission from a supply-led to a demand-led system and to introduce a hospital reimbursement system that would increase efficiency and facilitate regulated competition between health care providers. There are two reasons for developing an own-DBC system; firstly the existing DRG-based system was insufficient and did not result in the transparency required, and secondly, the Dutch wanted to construct a system that covered both inpatient and outpatient hospital care [26]. An additional reason was the desire to bring the incentives of medical specialists and hospitals into alignment, reduce income differences between similar specialties, and create transparency in the relationship between output and costs [10].

The foundation of "*DBC-onderhoud*" is an initiative of all major health care players in the Netherlands: the hospitals, the insurers, the physicians, the patient organizations, and the main function of this foundation is supplying users and user groups of the DBC-system with (online) help. A scientific advisory board has to support the operation of *DBC-onderhoud*.

DBCs include inpatient and outpatient care of medical specialists, which means that general practitioners (GPs), dental care and paramedical care are not covered by the DBC system. Rehabilitative care provided in hospitals is covered by the DBC case mix reimbursement system. Laboratory and imaging services performed as part of inpatient or outpatient specialist treatment are covered by the DBC reimbursement system. DBCs are based on (medical) process description instead of patient classification (which is the case with DRGs). The DBC relies on an episode-based registration within hospital. This implies that the codification process starts at the beginning of the care process and ends after the treatment completion. The maximum duration of a DBC is one year, and a new DBC is opened if the treatment proceeds more than one year. Hence, the type of care will be chronic periodical check up. That means a patient can meet more than one DBC in a treatment episode. Since its implementation in 2005, till now, all hospitals and medical specialists in the Netherlands demonstrated their acceptance towards this new hospital and medical specialist reimbursement system by registering to use the system.

3.2.1 Use in the Health Care System

The case mix system based on DBCs was introduced in the Netherlands in February 2005. The *DBCs* (characterized by combining ICD-10 diagnosis code and treatment) is a DRG-like pricing system used in the Netherlands describing all products that are provided in hospitals. A DBC defines the whole of the hospital and medical specialist activities and services arising from the demand for care by a patient consulting a specialist in a hospital. In this definition, “activities” refer to both medical and medical support services, such as outpatient visits, days of treatment, and number of days in daycare of the hospital and medical specialist. It constitutes the clinical pathway of the demand for the care of a patient, and represents the activities and services in the hospital associated with this demand. It covers the pathway from an initial consultation or examination all the way to the final check-up. To determine the price of a DBC, the use of the hospital's resources are linked to the activities of

services in the care process. These activities are nationally described beforehand, based on one particular diagnostic and therapeutic strategy that should be followed to achieve a DBC. If there are new medical developments, these guidelines will be updated by a DBC maintenance organization.

The Dutch system has 29,000 DBCs. To ease the billing process, these 29,000 DBCs are classified into 600 cost homogeneous product groups.The medical experts were involved in the determination of these DBCs, which are defined as the whole set of activities (diagnostic and therapeutic interventions) of the hospital and medical specialist starting from the first consultation and diagnosis of the medical specialist in the hospital until discharge. Unlike DRGs, a DBC is not based on the diagnosis of discharge, but relies on an episode-based registration within hospitals. As a consequence, the codification process starts at the beginning of the care process with the first visit of a patient to a medical specialist. During treatment the use of all hospital services is being registered. The codification process stops when the care process has finished.

One of the unique characteristics of the Dutch system is that it is possible to change the DBC registration during the treatment process. This occurs when a physician changes his opinion regarding the best treatment for the patient. In the Dutch system physicians have to register the DBCs, whereas in other countries, such as the US and Australia, this task has been delegated to official coders.

Episode of care is defined through three specified dimensions; type of care, diagnosis and treatment axis. The type of care is related to the type and phase of the treatment (for example regular care, emergency care or chronic periodical check up). The diagnosis coded according to the Dutch ICD-10 classification version and critical pathways, whereas the treatment axis expresses the setting and nature of the treatment, for example ‘chemotherapy with clinical episode’ or ‘expectative/follow up in outpatient treatment’. Dutch episode-based registration of hospital products is illustrated in Figure 3.2 below. One patient can have multiple DBCs and only the recent DBCs can be reimbursed. Each DBC is

characterized by a code combining information on diagnosis (based on the Dutch version of ICD-10) and treatment, and integrated in the DBC Grouper software to blend for the right DBCs.

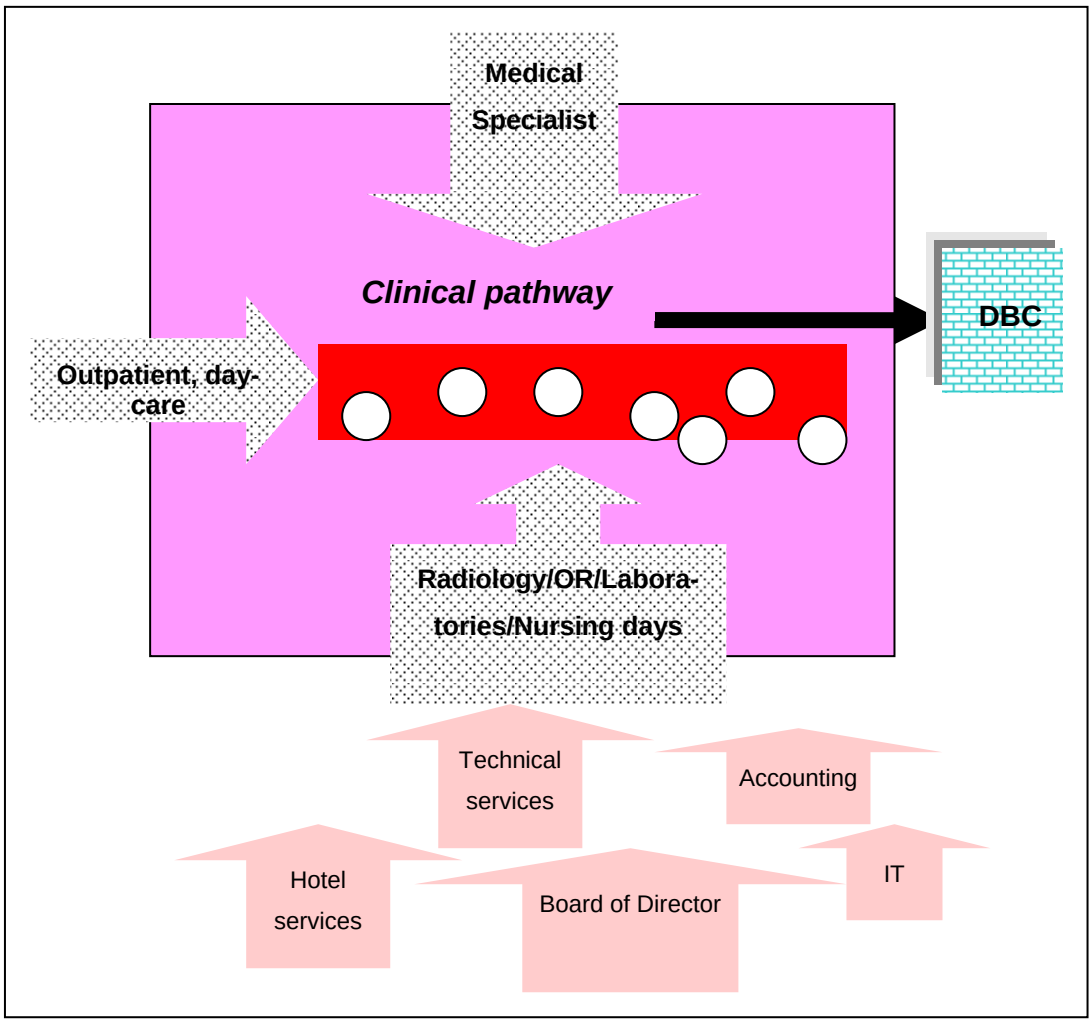

Figure 3.2: Episode-based registration of hospital products, DBCs with related intermediate products *Source: Elkerliek Hospital Helmond,*

3.2.2 The System itself

The DBC pricing system is uniformly implemented at the national level. The Health care Tariff Board/Health care Authority (*CTG/ZAio*) is a governmental organization responsible on issuing the tariff and determine the budget for health care organization and providers in the Netherlands. About 10% of the

hospitals' revenues result from DBCs with variable prices. The prices are negotiated between hospitals and medical insurance companies. The price of the remaining 90% of the DBCs is fixed and determined by the health care tariff board. The percentage of DBCs with negotiated prices is expected to increase steadily over the next few years. In the Dutch case mix system for-profit ownership is only allowed for some types of elective care.

There are two different DBCs pricing lists: List A for DBCs with fixed prices and List B for DBCs with negotiable prices, which both cover the honorarium of medical specialists and the hospital costs, including wages, medication, medical materials, overheads, housing and equipment but not the capital costs for the List A. The prices are annually updated by the National Office of Statistics based on weighted-price of wages and goods, with an assumption that two third of the hospital costs constitute costs of personnel, one third constitutes non-personnel costs. The services comprised in this list are within the hospital allowable budget. The hospitals, with these fixed tariffs from List A, oblige to charge both health insurer and patient. In contrast, List B comprises services that are not within the hospital allowable budget, such as treating major diagnoses like hip and knee arthrosis, diabetes mellitus, cataract and inguinal hernia. This budget is calculated, taking into account several structural parameters: the hospital's adherent population, the type of facilities present, the number of beds and the production parameters such as the number of bed days and outpatients visits. DBCs in the price List B vary based on negotiation done between hospital and health insurer. The capital cost is included in List B.

For each DBC on List A, the tariff for the hospital cost component is calculated as the average use of a health care service times the median unit cost of a service, summed over all health care services. The calculation of the honorarium component is based on time studies. For each DBC, the 'normal time' of specialist involvement has been determined and validated. For DBCs on list B, the relationship between prices and cost is function of the negotiation power of insurers and providers. DBCs prices are less biased by outliers due to the calculation made on the DBCs. List A was based on median not the mean.

The calculation for unit costs of hospital services involves the product costing model that was initially derived from 23 front-runner hospital dataset information. The model has become a standard model to calculate unit cost DBCs, and the model is simultaneously capable of differentiating between health care services (intermediate products produced from final cost centers) and DBCs (final products). Costs involved in the support cost centers (departments not providing patient care such as administration, billing etc) will be assigned to the final cost centers through a weighting methodology based on various allocation base. The determination of the unit DBCs cost in each hospital involves two parts of calculation: firstly, calculating the unit costs of intermediate products by dividing total costs per centre by the number of services produced for cost centers that produce only a single product. Those centers which produce multiple services will make use of the weighting statistics calculating the cost of services. In a second step the intermediate unit costs products are multiplied with the resource used profile. The outcome is then multiplied with the median unit costs of the intermediate products across all hospitals. The calculation summary of the product costing model is illustrated in Figure 3.3 below.

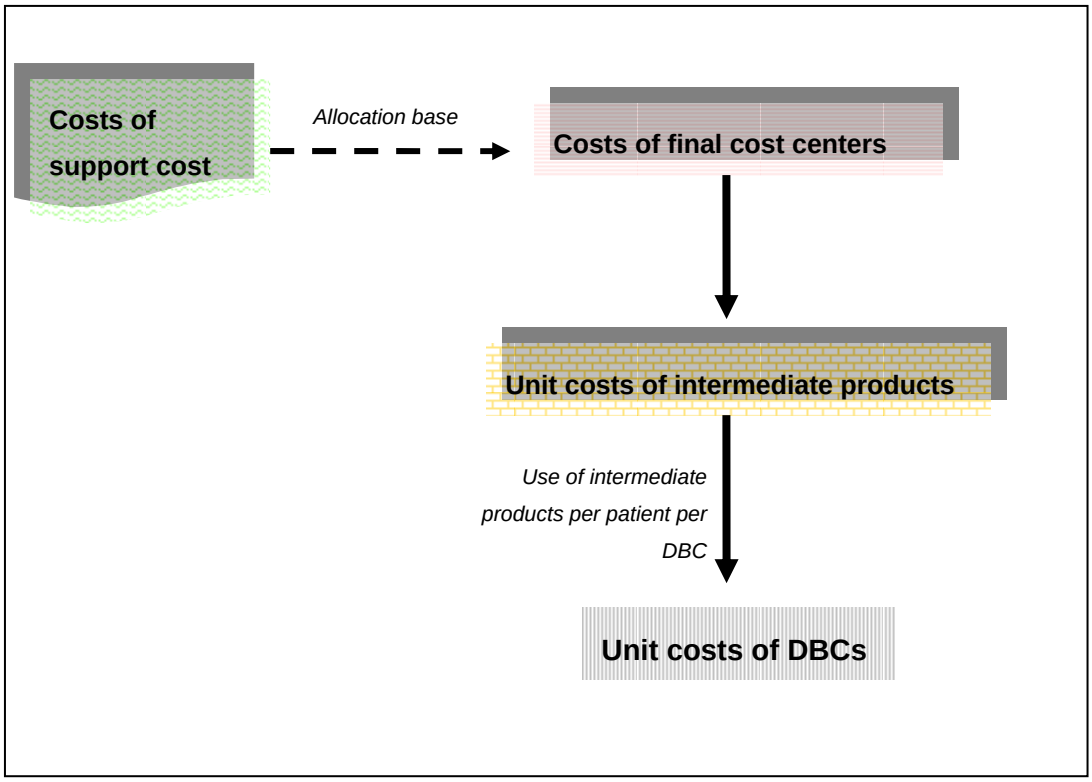

Figure 3.3: Product costing model to calculate the intermediate product costs and DBCs

In the current situation, reimbursement of List A DBC only serves as a vehicle to transfer money (the hospital's allowable budget) from health insurers to hospitals and medical specialists. The level of production is negotiated with insurers, and the result is an input into the calculation of the hospital budget. If the entire yield of DBC reimbursement exceeds or remains below the allowable budget, differences are compensated by a 'closing tariff' in the next year. The maximum production and the price of each DBC on list B result from negotiations between hospitals and health insurers. As a result, prices may also vary with the size of production and, for instance, parties may agree upon a lower or higher DBC price if production exceeds a predetermined figure.

With the DBC financing system, the Netherlands have set an ambition to improve the system and data collection and to further develop a structural incorporation of costs for building, education and outpatient medication in DBC-

logic. Implementation in mental health and extending DBCs to primary care are amongst the ambitions for the future.

3.2.3 Determination of Risk Factors within the System

Unlike DRG systems, risk adjustment within the DBC system involves continuous adjustment on indexation of tariffs and fees and some improvements in rates and/or fees in some specialties and/or products (as DBCs is defined as a set of activities provided). As earlier mentioned a uniform product-costing model is being used for calculating unit costs DBCs. Patient's in-hospital stay was largely determined by the procedure they received in the whole spectrum of inpatient care. The approach used and the algorithm considered in the cost accounting is linked to activity-based elements within the hospital. The product at the final costs center is elaborated explicitly in the case of multiple intermediate products, where the weighting statistic is used to assign the costs of the final costs centre to the various services.

Adjustment was done at the specialization level. For instance, at Ophthalmology department (Table 3.1), where adjustment was done by differentiating the cataract patients (DBCs 554) with the same diagnosis and treatment by the patients' insurance coverage (insured or uninsured patients) for DBC to DBC and a single DBC or outpatient DBC. To make advantage to this adjustment, the patient data set will be assigned with relevant performance code (functioning in reduce the Clinical without Days -). This will make each patient bill presenting a unique DBC of its own. Performance code can trace the same characteristics wherever the patients seek treatment.

Specialize AGB code	Type code	Care code	Diagnosis code	Derivative treatment	DBC declaration code insured care	Performance code
0301	21	-	554	31	151452	210005540031
0301	21	-	554	32	151453	210005540032
0301	21	-	554	33	151454	210005540033

Table 3.1: Example of the parameters used in Ophthalmology department for adjustment activity

Recently, there are four new codes for expensive medicines retroactively added in both of the DBC-health tables. The drugs are Alemtuzumab (190526), Palifermin (190527), Rituximab (e.g. for rheumatoid arthritis) (190528) and Infliximab (for ulcerative colitis) (190529). Other new products such as short-life blood products are as well introduced, whereby the hospitals must record the cost of blood and blood products to be allocated. The aim is to keep track the delivery and cost of short - sustainable blood products by DBC. This has resulted in sixteen codes which have been added to the new tariff table.

The cross-compensation on the dialysis DBCs are adjusted by monthly to weekly compensation based on DBCs tariff table. Whereas, for the psychiatry consultation, the declaration rate is adjusted based on the specified declaration code list.

Intramural care is classified in care-weighted packages (*zorgzwaartepakketten*). These packages are based on client profiles, a global description of the care in terms of functions, the total amount of care in hours and a description of the setting (place where the care is delivered, example 24 hour monitoring) and the conditions under which the care is delivered (according appointment at scheduled times or unplanned).

3.3 The Swedish use of the Nord-DRGs

The Swedish health care system is currently comfortable with a decentralized, public system involving national, regional and local government at the political and administrative levels to provide and evaluate health care. The central government is responsible in maintaining a legislative supervisory role, while the councils and municipalities are responsible for the financing and provision of health services. There are 87 hospitals which are public (owned and financed by the counties), 3 hospitals which are private and for profit and only a small minority of private and non-profit hospitals.

The funding structure of the Swedish health care sector is mainly based on taxes (local grant and county income taxes) and co-payments (2.5%). In 2004 (latest update is not available) Sweden spent about 9.1% of its GDP on health care, the largest share of which comes from taxes. It was slightly above the average for nations that belong to the OECD. Sweden experienced a slow growth in health expenditure, from 8.2% of the GDP in 1990 to 8.7% in 2001, and remains 9.2% from year 2002 to 2005 [57].

The NordDRG system is currently used as their health care financing modality, implemented at three levels of administrations; national, regional and local. There has been a movement of applying the DRG system, from the use of DRGs to “reimburse performance” to “describe performance”. This system is based on primary classified medical data and on the previously defined algorithm that group single care events into larger groups, which are consistent from both economic and medical perspectives. Most counties use the NordDRG system for management purposes and as a reimbursement system, where the usage as the latter tool varies across county councils as not all county councils are using the said-DRG system. Moreover, Sweden does not promote national compulsory use of this system as other Scandinavian countries do. The application was initiated by a few reasons; the long waiting-lists and the lack of incentives for providers to increase health care output owing to fixed budgets [4, 3].

3.3.1 Use in the Health Care System

The contract model (purchaser-provider concept) is relatively popular among counties in Sweden for reimbursements to hospitals within their own county while others, using case mix based payment systems for between counties reimbursements. The Swedish-NordDRGs have only been used for somatic care, including both acute and planned care but excluding psychiatric inpatient care, burn injuries and rehabilitation. In some counties specific regional care, some unusual and expensive drugs or materials might also be excluded and separately reimbursed. The exclusion list varies among counties. The use of the Ambulatory Payment Classification (APC) has been tested in Sweden. Stockholm County has an own-developed system called KÖKS system, used for the grouping and reimbursement of outpatient visits. The grouping methodology is focused more on cost homogeneity than clinical relevance. Similar systems have been introduced in other counties. It is in the plans for the national case mix office (*Centrum for PatientKlassificering*, *CPK*) to start a project for the development of a national case mix system for outpatient care. Latest developments in Sweden also include the development of case mix systems for description and funding of the psychiatric sector and the primary health care sector [48].

3.3.2 The System itself

The Nordic version of DRG (NordDRG) system has been adopted in Sweden since 1990's, initially introduced by the Swedish Planning and Rationalizing Institute (S*PRI*) of health as a payment system for acute inpatient care by some county councils, and further improved and maintained by the Swedish Association of Local Authorities and Regions. This system derives from the logic of the HCFA-DRG version 12 and it is created with openly accessible grouping definitions, based on ICD-10 and Nomesco Classification of Surgical Procedures (NCSP). Minor adjustment had been done on NordDRG version 1996 to establish the Swedish-NordDRG version 2002 that involved changes on

the neonatal groups. The hierarchical level of Swedish-NordDRG is illustrated in Figure 3.4 below. The first version of outpatient procedure based on NordDRG was developed and completed in 2002. Approximately, 70% of all cases are originally grouped from NordDRG listed for the nationwide Hospital Discharge Registration System. The major responsibility of maintaining and developing the NordDRG process is taken by the CPK.

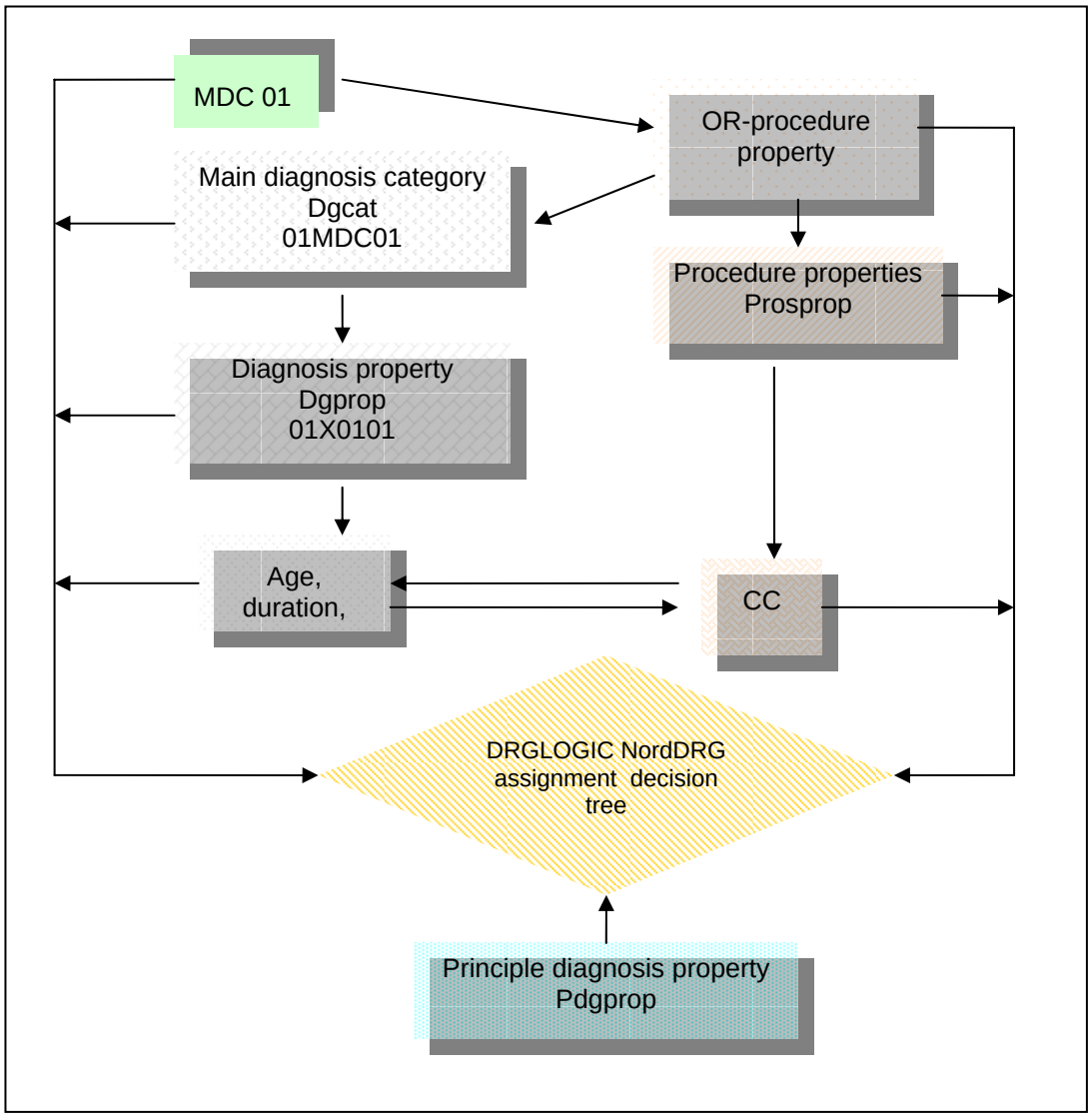

Figure 3.4: Swedish-NordDRG assignment process

In the light of its implementation, the combination between NordDRG system and the case-costing data is applied in order to have a payment system that is

consistent from both, medical and economical perspectives. The setting of case-costing (bottom-up costing approach) in Sweden is initiated by the Federation of Sweden County Councils that is compiling case costing data from 20 hospitals in Sweden to the national case-costing database for the calculation of the Swedish national DRG weights. Information about the activity, such as surgery, laboratory test, intensive care and nursing care are included inside the case-costing data. Uniquely, the national DRG-weights are based on individual patient related costs, which are calculated by distributing all costs in the case-costing to the individual case in patient specific services and mixed together with the patient characteristics.

Hospital information data was collectively stored inside the data warehouse (integration model), where all data is connected. The weight generated from the case-costing model involves four consequent steps; identifying the accurate total cost of the hospital, allocating indirect costs to the absorbing cost centre, identifying intermediate products and calculating their costs and finally, distributing products and costs to the patients. The weight for each DRG is calculated by dividing the average cost for each DRG with a cost that represents DRG weight 1.0 (equivalent to average DRG cost). It is basically up to every county council to decide their own calculation method. Commonly, the last year's average real cost for DRG-weights is used.

Case-costing contributed advantages to the Swedish health care system, where its application is broadly involved in the management support services for clinics and hospitals, the support to buyer of health care, important as benchmarking in cost studies and medical praxis, and is certainly greatly important for health care price calculation in the DRG system. Currently, case-costing for psychiatry, outpatient care and primary care are progressively done.

3.3.3 Determination of Risk Factors within the System

Adjustment on the national version of Swedish-NordDRG are made chiefly to adjust for the national variations of ICD-10 and NCSP with the aim of eventually harmonising the different versions.

In the Swedish national DRG-weights, costs for outliers are excluded from the Swedish-NordDRG reimbursement system list and the payment is separately done. The outlier limits are based on individual patient costs and also based on LOS as a service to those hospitals that yet having the case costing (or individual patient related costs). The rules for outliers apply only to the high end of the distribution. On the other hand, the low end is excluded as the cost of those cases is too low to be considered.

There are a few rules for identifying high-costs DRGs related to patient's LOS treated in tertiary hospitals with specialized units. Patients with coronary infarction who die within the first 3 days of the hospital stay, patients with burns remitted to other hospital within first 5 days of the hospital stay, and short therapy patient with a contact less than 2 hospital days (if the patient does not die) are subjected to a special DRG based on modified HCFA DRG.

The rules for neonatology in NordDRG are more complex. A patient who either died or was remitted to other hospitals will be assigned to "DRG 385A *Neonate, died within 2 days or transferred to other unit within 5 days".* However, this is not the case if either the patient who died during the hospital stay was treated in that hospital longer than one day and one night (during more than 2 calendar days) or the patient who was remitted to an other hospital and was treated more than 5 days in that hospital or if neonatal intensive care procedures were performed for that patient.

In the coding process (applying ICD-10 codes), two codes marked with an asterisk (*) and a dagger (+) are used, which respectively indicate the symptoms or manifestations of a disease and the etiology of the disease are needed to define one diagnosis. Each diagnosis may only belong to one

complication categories (COMPL), where the category of each patient case is determined by the secondary diagnosis. Complication categories may appear in two forms; active and inactive CC-categories. The difference between those two CCs is the former CC-property of the patient will turn positive, unless the principal diagnosis is on the exclusion list for that CC-category. Whilst, activation is needed by the latter category by other diagnosis property of another diagnosis to turn active. Without activation, the inactive CC-category does not affect the DRG assignment in any way. In the condition where the CC-categories may possibly be given the same diagnosis two times, the exclusion lists for each CC-category comprise those diagnoses that belong to the same 'family' available to avoid complication in determining the right diagnosis.

Age is always calculated as days at admission by applying six different age limits: patient with principal diagnosis only applicable to children cannot be older than 17 years (6,574 days) of age, patient with principal diagnosis only applicable to adults can not be younger than 14 years (5,114 days) of age, obstetric patients may not be older than 56 years (20,440 days) of age or younger than 11 years (4,018 days) of age, neonatal patients have several age limits while the standard neonatal patient may not be more than 1 year old (365 days) at admission, patients may not be more than 125 years (45,654 days) of age, and for children (except neonatal DRG's) the patient may not be older than 18 years (6,574 days) of age.

3.4 The French Groupes homogènes de maladies (GHM)

Frances employs a system of a statutory health insurance (l'assurance maladie), contributions to which are mainly paid by the employers (2006: 12.8% of gross income). Employees only pay 0.75% of their income to the statutory health insurance. On the other hand, relatively high co-payments are required when services are utilized [47].

The expenses of the statutory health insurance (*l'assurance maladie*) in France amounted to 135 Billion Euros in 2005, 61.1 Billion Euros of which were spent on hospitals [14]. The costs for research and teaching as well as investment funds are supplied by the statutory health insurance as well. The government contributes less than 40% to the costs for investments.

Approximately 65% of the hospitals in France are public hospitals. 20% are privately owned while 15% belong to other institutions. Hospitals provide apart from in-house surgical, medical, obstetric and psychiatric treatments also certain ambulatory care and rehabilitation. Public and non-profit hospitals always worked on a global budget and are not financed on a per-case payment, while private hospitals used to work on a fee for service basis.

3.4.1 Use in the Health Care System

Since 2004 the financing of hospitals undergoes major changes in France. In a period of convergence historical budgets, which were not derived from the output of a hospital, are transferred to budgets that result from the output measured by the GHM. This process ought to be accomplished in 2012 and comprises the private hospitals as well. The GHM are supposed to contribute to a more equitable regional distribution of budgets. Momentarily regional supplements that compensate for historic differences still exist. Not comprised by the GHM are psychiatric cases, rehabilitation, most of the ambulatory care, dialysis at home and parts of the transplantation medicine and emergency treatments. Furthermore per diem rates for treatment on intensive care units are

financed separately from the GHM-system. On the other hand ambulatory chemotherapies, radiotherapy, coronary angiographies and some of the ambulatory surgery are part of the GHM-system. For rehabilitative care a separate Classification (*SSR - Soins de suite et de réadaptation*) was developed, the development of a Classification for psychiatric treatment is in progress. Expensive and innovative drugs or implants (example. pacemakers, heart defibrillators, cardiac valves, brain stimulators, etc.) are financed by additional payments and therefore are not covered by the GHM.

3.4.2 The System itself

The GHM derive from the third version of the HCFA-DRG from 1985 and have been supplemented 1997 by elements of the AP-DRG Version 10 of the GHM consists of 782 different groups (not containing error groups). There are 27 different Major Diagnostic Categories (CMD). The GHM system distinguishes between surgical and medical partitions. Adjacent DRG are not used. Exceptional is the CMD 24 that lists 154 groups for ambulatory care/surgery (LOS less than 2 days).

When the hospital stay exceeds an upper trim point a daily surcharge is allowed for. When the LOS falls short of the lower trim point (and patients have not deceased) only 50% of the lump sum is accounted for.

The *Agence de traitement de l'information hospitalière* is responsible for calculating and maintaining the national cost weights. The weighting of the GHM in the cost calculation relies on a trimmed mean. In contrast to other DRG systems the trim point for the cost calculation are not defined by LOS but by costs. The calculation is based on the hospital cost data set provided by the 52 reliable and quality participating hospitals.

Different from all other DRG systems is the way the principal diagnosis is determined within the GHM system. The principal diagnosis should be the one that required most of the resources (approximate to the WHO definition). As the French dataset consists of different datasets for each department in which the

patient was treated, the principal diagnosis for the GHM grouping is determined by an algorithm that aims to choose the correct principal diagnosis corresponding to the above mentioned principle. In this algorithm surgical procedures, length of stay and department of discharge are used. Asterisk codes for manifestations are used as principal diagnoses instead of the aetiology codes listed in the ICD-10.

3.4.3 Determination of Risk Factors within the System

As in most DRG systems additional diagnoses are used to identify high cost patients. The GHM are not a refined DRG system though. Similar but not identical to the AP-DRG system diagnoses for the GHM are differentiated in relevant and severe complications and comorbidities (CMA - *Complications et morbidités associés*, CMAS - *Complications et morbidités associés sévères*) and defined on the level of the Major Diagnostic Categories (CMD). There is a list of CMAS for traumatic and non traumatic complications and comorbidities respectively.

Cases with severe complications and comorbidities (CMAS) are collected in not specific accumulated GHM on the level of the Major Diagnostic Categories (CMD). For cases with relevant complications and comorbidities (CMA) specific GHM are possible, sometimes combined with age criteria.

Parallel to the introduction of the CMA and CMAS lists, exclusion lists were established. They refer to the principal diagnosis, so if a diagnosis is listed in the specific exclusion list for a principal diagnosis it cannot count as CMA or CMAS. The exclusion lists were deliberately defined according to medical and not statistical reasoning. So are for example symptoms of the principal diagnosis or related diagnoses not considered as CMA or CMAS. Important in this context is the different definition of the principal diagnosis in the French GHM system.

The other major risk adjusters in the GHM system are splits defined by age (28/120 days, 2/18/70/81 years). There are both GHM defined solely on and both on age and CMA.

GHM for Neonates are similar to other DRG systems differentiates by admission weight.

As most other DRG systems the GHM provide specific CMD and groups for cases with HIV, transplantation medicine and polytrauma.

As the treatment on intensive care units is accounted for by per diem rates outside of the GHM system a special consideration of hours of mechanical ventilation or special scoring systems is not regarded as necessary within the GHM system. However to benefit from the additional per diem rates special requirements must be fulfilled. Apart from structural qualifications one of 40 different diagnoses must be coded together with a minimum of points in the IGS-II score (translation of the SAPS II).

Severity indicators for the ambulatory GHM (CM 24) are not used, however the mode of discharge (death, transferral into another hospital) will lead to a grouping into two special GHM.

In special circumstances cases can be assigned to more than one GHM simultaneously. This is possible for dialyses, radiotherapy, the hyperbaric oxygen therapy and specific implants and represents a form of additional payment.

When multiple services that are related to different CMD are provided from a single department the case will be assigned to an error group.

Like in all one-dimensional DRG systems the representation of complex and multiple treatments poses a problem. Therefore France is testing a system in which a case can be regularly assigned to more than one GHM. This system, which is called *Effeuillage Progressif* (*EfP*), does not use the classic risk adjusters (CMA or CMAS, age) anymore but a complex system of primary GHM

(*GHM élémentaires*) and additional or secondary GHM. Each GHM obtains apart from the normal cost weight a sensibility coefficient and a complexity coefficient. The first is used when the GHM is primary GHM, the latter when the GHM is secondary. A case is then weighted by the cost weight of the primary GHM and the complexity coefficient of the secondary GHM which is/are again weighted by the specific sensibility coefficient of the primary GHM. Cost weights would not be calculated anymore as means but determined by multivariate statistical analysis. First analyses show a reduction of variance by 10% and a reduction of necessary GHM down to 370.

The summary of results is tabulated in Table 3.2 and Table 3.3 for the countries' health care system and prospective payment system in use, respectively.

Country	Grouping system in-use	Structure of the health care system	Objective of DRG employment
Germany	G-DRG *(introduced in 2003 adapted from AR-DRG, v 4.1)*	The healthcare system preliminary determined by national rules and legislations. Dual funding system is practiced. The financing system is via compulsory social insurance contribution and/or additional private insurance. Taxes are meant for investment for hospitals	Principally used more towards pricing system. The system is nationally implemented and geographically decentralized. All inpatients and some day cases included in the DRG coverage, while psychiatric care, ambulatory care and rehabilitation are excluded.
Sweden	Swedish-DRG *(based on Nord-DRG)*	A decentralized public system for financing, providing and evaluating healthcare activities. Central government which has a legislative supervisory role. County councils are responsible for financing and providing almost all health services. Local municipalities have same responsibilities as the counties but only for elderly care and disabled The financing is effected mainly by local and counties' income taxes and patients co payments (2.5%)	
The Netherlands	*Diagnosis Behandeling Combinaties (DBC)*	The Dutch health care system is more market oriented. The Dutch government plays a major role in planning and regulating the health care sector. The central government is shifting responsibilities towards the health care providers and health insurance organisations; more self-regulation based on market principles.	The main objectives of introducing DBC were to increase transparency of hospital and specialist care, to realize the transmission from a supply-led to a demand-led system and to introduce a hospital reimbursement system that would increase efficiency and facilitate regulated competition between health care providers.

Country	Grouping system in-use	Structure of the health care system	Objective of DRG employment
France	GHM *(based on HCFA-DRG)*	The French system is a national system with some regional Customization, where the role of the national level is to define the rules and the regional role is to conduct planning and to sign "goals contracts" but recently since the beginning of French DRGs the role of the national government has increased. As a result, the calculation of hospital budgets is made at the national level. The financing is based on compulsory social security for all citizens	Aim to improve efficiency and harmonize prices and payment methods between the public and private sectors.

Table 3.2: The summary of the health care systems, prospective payment systems and the objectives of employment in Germany, Netherlands, Sweden and France

Grouping system	The taxonomy of DRG	Cost accouting	Risk factors
G-DRG	Main grouping criteria based on diagnosis, procedures, age, co morbidity, cause of discharge. A total of 23 MDCs, involves 1137 DRGs and severity levels expansion from 4 to 9 levels in version 2008. Coding definition is by ICD-10-GM and OPS-301 procedure classification Differences in their financing rate is presented. Hospital-specific DRG revenue per cases exclusively presented from each hospital Financing outliers within DRG system are based on LOS that is applied to the low and high end of the distribution.	DRG cost weights, DRG price and determination of risk factor are based on hospital cost and claim data set from 214 participating hospitals. The calculation of the DRG weight works in full cost accounting (average related cost) instead of service weights. DRG weights are based on costs. And the cost weights are uniformed at national level	PCCL, principal and additional diagnoses, complex procedures, procedure functions, age, hours of mechanical ventilation, multiple procedures on different dates, length of stay, same day case, admission weight and mode of admission or discharge
Swedish-DRG	Applied for acute care and planned care and excludes non-somatic care. The exclusion list varies among counties. Sweden has no national DRG policy Outliers only applied to the high end of distribution of individual patient costs and LOS. For the low end only cases with too low costs are excluded.	DRG prices calculated according to the case-costing of 20 specific hospitals. The average last year's real cost. Is adjusted by the budgeted differences for expected cost or estimated increase in productivity next year. DRG weights are based on costs.	LOS, PCCL, age
Diagnosis Behandeling Combinaties (DBC)	The DBC system is nationally implemented, it is used for acute care hospitals including inpatient and outpatient care of medical specialist. As well as rehabilitative care, laboratory and imaging services for specialist treatment. The system offers a framework of product definition and cost allocation. Prices of DBCs of List A are calculated on the basis of a median instead of mean. Consequently, the prices are less	The DBC case-mix system involved the adoption of a uniform product costing model to calculate unit costs of DBCs. Pricing and quality system are uniformly implemented at the national level. DRG weights are based on full cost methodology, which involves 23 hospital costing data sets.	The activity-based elements within the hospital are adjusted, where the product at the final costs centre is elaborated explicitly in the case of multiple intermediate products.

Grouping system	The taxonomy of DRG	Cost accouting	Risk factors
	biased by outliers.		
GHM	The French GHM system is nationally and uniformly applied for all kinds of hospitals providing acute care (public, non-profit and for profit). Ambulatory chemotherapies, radiotherapy, coronary angiographies und some of the ambulatory surgery are part of the GHM-system. Not covered under GHM are psychiatric cases, rehabilitation, most of the ambulatory care, dialysis at home and parts of the transplantation medicine and emergency treatments. Per diem rates for treatment on intensive care units are financed separately from the GHM-system. Use of a similar system for not-for-profit and for profit hospital with a convergence of tariffs between the sectors. Tariff/ price for GHMs are based on hospital activity level on the previous year, and it is adjusted with geographical correction factors.	DRG weights are based on costs. The tariffs or prices and cost weights are based on the same scale, which costing data set obtained from 52 participating hospitals.	CMA and CMAS, age, admission weight for neonate, usage of mechanical ventilation, separate category for HIV, transplantation medicine and polytrauma, mode of discharge, multiple services, and complex and multiple treatments

Table 3.3: The summary of the DRG system taxonomy, the cost calculation and the risk factors employed in Germany, Netherlands, Sweden and France

4 Discussion

4.1 National Differences in Determination of Risk Factors

The results indicate that the main objectives of implementing DRG systems are profoundly determined by each country. The strategy of achieving the objectives for fair hospital reimbursement and creating homogeneity within the DRG pricing system are straight forward. Observing into each country's Manual DRG Classification Guideline, intense risk adjustment on the selected DRG parameters or product elements have been done primarily to generally ensure that the costs variance within the DRGs is consequently reduced.

Adjustment has been applied in various ways that involve various risk factors. Each proxy country demonstrated different numbers and types of risk factors adjusted. However, they show similarity of choosing patient's severity, age and length of hospital stay to be adjusted. The Netherlands, exceptionally are making use of the activity-based element to adjust for the high-DBC price, and actually had included those three algorithms mentioned above in their product costing, which is unfortunately, implicitly presented in the DBC manual. Due to this difference, DBC will be separately discussed.

Although Germany and France are considering more risk factors to be adjusted for high-costs DRGs within their systems as compared to Sweden, however, there are two algorithms they have in common; PCCL and patient's age are risk factors highlighted in this study (Figure 4.1).

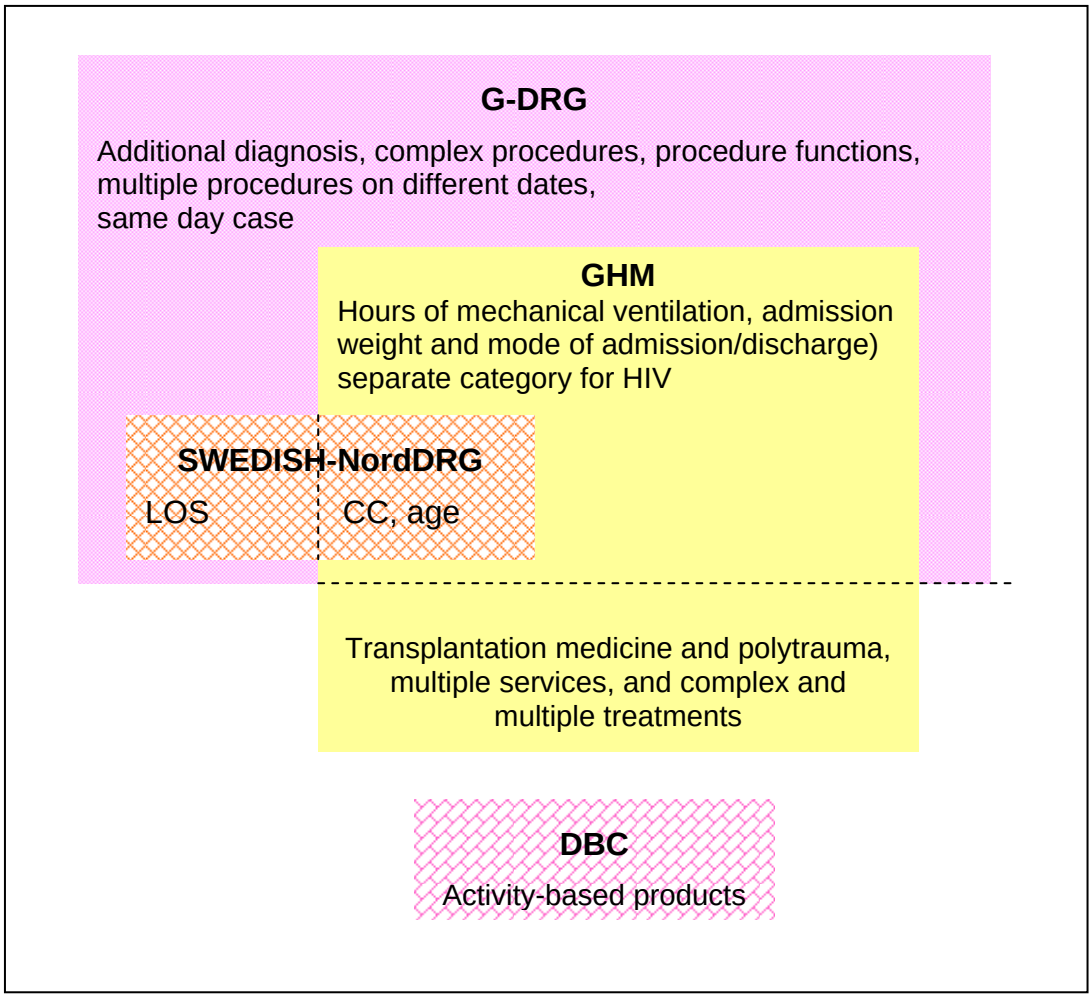

Figure 4.1: Venn diagram simplifying the similarities and differences of risk factors applied in each country

Severity of illness is associated with higher costs. PCCL in certain circumstances can be related to a treatment on an ICU in the German, Swedish or French system. ICU treatment again is associated with the usage of mechanical ventilation or artificial respirators. However, the usage of ventilator apparently is not considered within Swedish-NordDRG. Instead, the G-DRG and GHM systems are considering the usage hour of the ventilation as those that need to be adjusted for high-cost DRGs.

Notwithstanding, upon having quite a number of risk factors, G-DRG and GHM systems have determined other risk factors that are considerably unique for

their own as demonstrated in Figure 4.1. This reflects the nature of the patients treated within the inpatient care facilities in each respective country.

There are various ways of manipulating the risk factors to encounter the problem of DRGs cost variance. As we can see, all proxy countries (with exception of the Netherlands) split the case type into two or more parts according to clinical attributes such as diagnoses or method of treatment, and then setting different payment rates for each. Splitting by the need for intensive care is an indicator that has been widely reported. It is indicated that there are many DRGs that contain patients with demand for intensive care and leave others, who do not need the service in a large variation in actual costs of care. The rationale is, however, if the DRG was split into two parts, calculatively the variations within classes would be greatly reduced. Separate payment rates practically, could then be set for each part. In the case of DRG classification, it is a normal part of periodic updating to explore whether splits involving the variables already used to define DRG boundaries will improve the homogeneity of selected DRGs.

The Dutch DBC system cannot be comparatively discussed with DRG-Systems in full because the system is ultimately unique at its own. The DBC payment system is a DRG-like system but different in many ways. Fixed tariff is issued for DBCs so that the hospital cost component, taken into account the median unit cost of the service. Subsequently, in the DBC system less outliers occur in the costing system, However, DBC continuously committed to risk adjust their product list costing by accomplishing necessary changes to rules and regulation of the intermediate product at various departments particularly at specialty department for DBC cost balancing.

In addition to the unique criteria of Dutch DBC, the system has another option of screening the high outliers. It involves the use of care pathways, where part of the process involves recording whether a patient remained on the pathway, or whether there was a significant deviation. If a deviation (or variance) occurred, it is good clinical practice to record it for later review. A subset of reasons why the

patient deviated can be selected as the basis for making additional payments. These are equivalent to high outlier payments.

The variation of risk factors highlighted in this study are probably due to several fundamental aspects of DRG costing for the respective DRG system. Differences in the definition of data samples, differences in the choice of methodology applied to determine the outlier cases (and subsequently high outlier cases) and differences in the methods for calculating individual cost weights or reimbursement rates or prices are amongst fundamental reasons for the risk factor variations to be discussed.

In regard to the first reason, the numbers of hospitals from which cost data are collected and pooled are different among countries. For example, *SPRI* Sweden initially collected costing data from only 20 hospitals as a basis for national case-costing model calculation much less as compared to the number of participating hospitals received by InEK (214 hospitals) to calculate the cost weights for the G-DRGs. The Dutch calculated the average DBCs costs and set tariff for DBCs on List A based on information from 23 front-runner hospitals (together with unit costs of intermediate products) and France collected 52 hospital data sets for the same reason (Table 3.3). Usually the distribution of hospital costs is highly skewed, and the selection of outliers is sensitive both to the criteria used and to the underlying distribution. These calculations could be improved if many more hospitals participate by contributing their hospital costing and claim data for the national calculation purposes. These criteria usually seek to balance the need to ensure high-quality data standards with obtaining a representative sample of hospitals.

Pertaining to the second reason, the outlier's determination process usually involves a standardized mathematical trimming method to eliminate the frequently occurring deviations of extreme resources used. This process usually involves several trimming methods that yield different results [37, 36, 41, 42]. For this purpose, parametric or non-parametric trimming methods are applied by these countries to define threshold values (trim-points). Germany and France

applied parametric method with plausibility checking in their trimming process resulting in a robust mean value. While Sweden has applied a non-parametric approach to determine the trim point, the Netherlands do not correct the outliers because they do not calculate the DRG cost weights [26]. The main difference between these two approaches is that the variance within the DRG on the trim point is significantly higher for parametric method [9]. As a consequence, the cut of point for high outlier would be rather high for the high-cost cases. Therefore the choice of method must depend on the characteristics of the data sample as well as on the goals that health care policy makers intend to achieve by using DRG systems.

The final fundamental reasoning to explain the risk factor variations is the differences in calculating the cost weights or reimbursement rates or DRG prices. Different approaches are currently applied to determine DRG prices. In Germany and Sweden for instance, DRG cost weights calculation is applied to set for DRG prices, whereby the risk adjustment in both countries is regionally differentiated. Whereas France directly determines the prices based on the prior setting of prices for each DRG (calculation based on the average costs per DRG) and risk adjustment of DRG prices differentiated at different levels of care [8]. The Dutch are defining their reimbursement rates based on the price of the medical procedures performed. Clearly, differences of reimbursement mechanisms and reimbursement rate definitions could contribute to the risk factor variation in this study. Figure 4.2 illustrates the defining reimbursement rates and types of reimbursement systems for the selected countries.

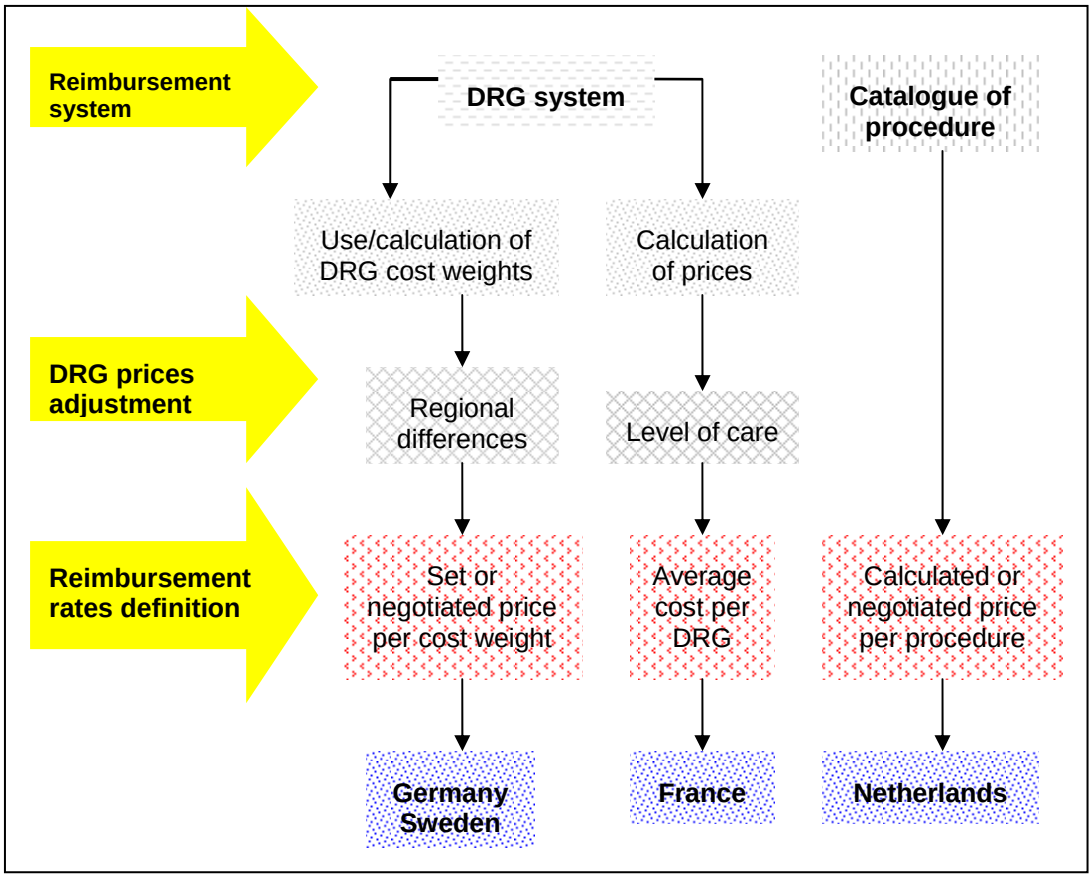

Figure 4.2: Different types of reimbursement systems and defining reimbursement rates employed in Germany, Sweden, France and the Netherlands

Additional factors that relate to the cost weights are, that there are countries that apply the DRG system uniformly (example Germany), while others apply different sets of cost weights (example Sweden), depending on the administrative unit responsible for the provision of hospital care. There is also a variation related to hospital ownership, implying that cost weights may depend on the financing structure of the health care system as a whole.

4.2 Dependence of Risk Factors Determination on the Structure of National Health Care System

As shown in the chapters above different nations with different Health Care Systems use different risk factors within their DRG systems. The crucial question is whether and to which extend the structure of the national health care system influences the selection and development of risk factors for DRG systems.

DRGs have not always been used solely for financial reasons. This is demonstrated in some countries that use DRGs as instruments of management, benchmarking or health statistics. The effects of the implementation of DRG systems give a good picture of their diversity. Countries that decided to implement more recently DRGs favor mainly for financial use. The fundamental challenge for most hospitals under DRG reimbursement is the economic survival. In most health care markets exists strong competition. Thus, a process of engineering (improvement of operational and organizational structure) is absolutely necessary.

4.2.1 German health care system and risk factor determination

In Germany, the involvement of the government is limited to the management of infrastructure and legal regulations. The InEK supports the contracting parties (hospital organizations and the insurance companies) with the introduction and continuous development of the G-DRG system. The InEK is responsible for the calculation of the cost weights and the annual adaptation of the G-DRG system. The cost weights per DRG are calculated from the average costs per case in the contributing sample of hospitals, and it is uniform at national level. The price per DRG results from the multiplication of its cost weight with the base rate at the federal state level. Furthermore, negotiations held between hospitals and insurance companies are important for cases that are not part of the DRG budget.

There has been no scientific evaluation of the impact of G-DRG system implementation within this dual financing health care structure yet. The sole costs for developing the system were acceptable. Apart from encountering the hospital economic risk due to the high-costs cases, risk factor determination done by InEK seems to support the ambition to improve the G-DRG system with increasing precision by reproducing the real relation of costs of hospital services within the yearly analysis of case-related cost data. Parallel the intention to have more transparency and a fairer remuneration in hospital financing and the incentives for a more economical delivery and efficiency in the utilization of resources has been backed.

4.2.2 Swedish health care and risk factor determination

In Sweden, the three levels of independent government; the national government, the county councils and the municipalities are all involved in health care with the goal to equalize 95% of the income differences and 100% the differences in need [4]. Although decision-making is highly decentralized to local governments, overall goals and policies are determined at the national level. Existing variations in the supply and costs of health services across local governments are all linked to different priorities. Local government raises most of its revenue by levying proportional income taxes on the population, but about 20% of local government funding is supplemented by central government grants. While CPK is responsible to produce national prospective weights for NordDRG (inpatient and outpatients), the county councils in some cases, setting own payment levels for services under DRG assignment. It is due to the loose implementation (not mandatory) of using the national weight sets and flexibility for the local authorites to use their own local weights in the counties. As a consequence, a variation exists in the methodology used for calculating the DRG cost weight in this country. Even the DRG price lists for each hospital in and between counties are different due to different technical and ideological reasonings. Therefore, the scenario above reflectes the monopolistic model of

health care system, which decisions in regard to manipulating the identified risk factors are based on the county level on local issues. Hence, the system of Swedish-NordDRG financing is endurable for the hospital sector and the health care authorities

Although the objective of employing the NordDRG system (to increase productivity, transparency in hospitals activities, the creation of a common "language" between professionals and administrators, a financing system that focus on hospitals activities instead of organization, a description of performance in a better way and the realization of a tool for benchmarking) is claimed being realized, however, there are still various needs to be resolved. It is commonly suggested that there should be dealt with cost outliers and to get new groups when new drugs or devices or new technology come in-use.

4.2.3 French health care and risk factor determination

Like other countries, France is comfortable with the Assurance Maladie, the scheme that reimburses health costs for medical consultation, medical examinations and treatment in doctors' surgeries and in hospitals. The national tariff applied within the GHM system is differentiated by the way the tariff is calculated for profit and non-profit hospitals. GHM are applied at acute care hospitals, and used for inpatients and day cases for medicine, surgery and obstetric specialties: The national cost weights calculated by the *Agence de traitement de l'information hospitalière* actually comprise high-cost cases that were initially attached behind the backdrop of principle diagnosis. Risk adjustment was established within the system to encounter the costs variation attributed by these high-cost cases, whilst parallel to the centralized national health care focus to improve efficiency and harmonize prices and payment methods between the public and private sectors.

GHM have certainly increased transparency in hospital activities and the system has been accepted by the hospitals, although some difficulties had to be

overcome. However, the most quoted suggestions in France in respect to the useful changes for GHM-financing arise from the ethic and deontological problem, care accessibility for patients and the choice of patients by hospital and certainly private hospital or clinics.

4.2.4 Dutch health care and risk factor determination

In the Dutch DBC reimbursement scenario, the system's complexity is justified by their high transition costs. Maintenance, registration and validation of DBCs are complex and the associated costs are deemed too high. Moreover, the functioning of the DBC system is highly dependend on the cooperation of hospitals and medical specialties [26]. This system facilitates negotiations between health insurers and hospitals on prices (on a bilateral level). Risk adjustment on the identified high-cost products instead of to reduce the costs variation, is also meant for the product costs negotiation for a fair price. Reviewing the hospital reimbursement in the Netherlands, the hospital budget is determined by the allowable costs (the national fixed DBC-rate from List A), whereby the tariff is issued by the *CTG/ZAio* and approved by the Minister of Health. Obviously, there is no connection between prices and unit cost presented.

It is at a too juvenile stage to be assessed, whether the objective of its employment is or will be realized. As yet, doubtful arguments arise towards the awareness for the output, quality and efficiency of hospital and medical care based on the limited national data of resources-use-profiles as a basis of the national case-costing.

4.3 The Future Determination of Risk Factors in DRG Systems

The primary purpose DRGs have got to offer is an accurate cost assessment of treating a given patient in the light of observable and measurable patient

characteristics. In this role, the main challenge is to determine the potential high-costs cases in order to ensure the risk adjustment process is unbiased and accurate. Technically, DRGs should be based on both economically and clinically meaningful groups. That requires careful decisions on the design of the DRG system, such as the hierarchy and algorithms used to classify patients into a limited number of groups. Economically, patients within one group should have homogeneous costs. Clinically, cases allocated to one group should form a distinguishable entity based on main diagnosis, severity, co-morbidity and/or treatment performed.

Otherwise DRG-based payment systems would pose unwanted incentives in the care strategies for high-cost cases. The DRG system itself is unable to reduce the total costs of inpatient care because the effect of DRGs will be only the redistribution of resources. For hospitals which do not control the terms of the reimbursement ratio to costs, consequences could be dramatic. The discussion covered in this study may not be fully comparable as the countries use different DRG systems with different diagnoses and clinical procedure groupings. Apparently, there are large variations in the number of groups across the different systems in use.

The variation of risk factors identified in each proxy country may be technically due to several differences in the DRG cost accounting methodology. As in all countries which have adapted this form of financing, it would be necessary to have data from a sufficient sample of hospitals to base funding on an acceptable empirical foundation. Therefore, the hospitals within a complete system of per case charges based on DRGs, should have an own interest in limiting its costs. Calculation of cost weights is crucial in the reporting of hospital care outputs and the method used to calculate individual cost weights that varies between countries is one among other factors that contributes to the variations of the hospital reimbursement rate. And hence, a factor that lead to a different selection of risk factors within DRG systems of those countries.

The influence of the national health care structure towards the determination of risk factors within the proxy countries is profoundly explained by which country with a social health insurance system will generally encourage the competitions between public and private hospitals by applying the same reimbursement system to all providers, for instance, Germany, France and the Netherlands. Whereas, countries with primarily tax-financed system, use a DRG system to set reimbursement rates between different regions as part of a regionalized system as presented in Sweden.

It is a fact that no international DRG system has so far been developed that would permit international comparisons. A move to develop an international DRG system is required for ongoing measurement activities in the hospital sector. An international system would also be able to confront differences in the applications of DRGs which limit comparability such as the treatment of outliers and the calculation of cost weights. Thus, international comparisons of hospitals require developing a common weighting set. Such a set could be built on the basis of a cross-country sample of hospitals which have high-quality patient level data and cost accounting. In this regard, a standardized methodology of collecting health expenditure data becomes of paramount importance.

The European DRG systems are rather substantial, the systems have diverged and followed different paths over the past two decades. Hence, the systems reflect different preferences in medical practice and new technologies. As a consequence, harmonizing European DRG systems and sharing the same risk factors for high-costs cases within the DRG systems do not seem to be realistic in the short or medium terms. However, in the long term some kind of European DRG system may be created for a cross-border movement within the EU. If case mix policy is to maintain credibility, the funding arrangement must respond to changes in the cost structure of hospitals and meet increases in demand [18, 41, 42]. This study could serve as fundamental information for future activity of outcome research of DRG variation.

5 References

1. Almas H. (2002). Productivity measurement in Swedish departments of gynaecology and obstetrics. Struct Change Econ Dynamics. 3:315-336
2. Altenstetter C. (2003). Insights from health care in Germany. Am J Public Health. 1:38-44
3. Anell A. (1996). The monopolistic integrated model and health care reform: the Swedish experience. Health Policy. 37:19–33
4. Anell A. (2005). Sweden healthcare under pressure. Health Econ. 14 (Suppl 1):237-S254
5. Antioch K.M., Ellis R.P., Gillett S., Borovnicar D., Marshall Ric P. (2007). Risk adjustment policy options for casemix funding: international lessons in financing reform. Eur J Health Econ. 3:195-212
6. Antioch K.M., Walsh M.K. (2002). Risk-adjusted capitation funding models for chronic dieses in Australia: alternatives to casemix funding. Eur J Health Economics. 3: 83-93
7. Antioch K.M., Walsh M.K. (2004). The risk-adjusted vision beyond casemix (DRG) funding in Australia: International lessons in high complexity and capitation. Eur J Health Econ. 5: 95-109
8. Bellanger M.M., Tardif L. (2006). Accounting and reimbursement scheme for inpatient care in France. Health Care Manage Sci. 3:295-305
9. Cots F., Castell X., Elvira D., Saez M. (2003). Relevance of outlier cases in casemix system and valuation of trimming methods. Health Care Manage Sci. 6:27-35
10. Custers T., Arah O.A., Klazinga N.S. (2007). Is there a business case for quality in The Netherlands?: A critical analysis of the recent reforms of the health care system. Health Policy. 2:226-239
11. David M.S., Sharon L.T.N. (2008). Comparison of “Risk-adjusted” hospital outcomes. Circulation. 15:1955-1963

12. Dudley R.A., Medlin C.A., Hammann L.B., Cisternas M.G., Brand R., Rennie D.J., Luft H.S. (2003). The best of both worlds? Potential of hybrid prospective/concurrent risk adjustment. Med Care. 1:56-69

13. Gustaf K., Sven S. (2007). Activity-based financing of health care – experiences from Sweden. Int J Health Plann Mgmt 22:25-44

14. Heller M. (2007). Die Krankenhausfinanzierung in Frankreich. Ein aktueller Bericht über die DRG-Entwicklung. Das Krankenhaus. 2:113-125

15. John S.H., Richard F.A., Jon E., Norbert I.G., John M., John M.N., James C.G. (2004). Clinical risk groups (CRGs): A classification system for risk-adjusted capitation-based payment and health care management. Med Care. 1:81-90

16. Kutzin J. (2001). A descriptive framework for country-level analysis of health care financing arrangements. Health Policy. 3:171-204

17. Lehtonen T. (2001). In serch of efficiency – NordDRG based pricing and case-mix accounting. Helsinki: Helsinki School of Economics and Business Administration, Department of Accoutning and Finance

18. Lungen M., Dredge B., Rose A., Roebuck C., Plamper E., Lauterbach K. (2004). Using diagnosis-related groups: The situation in the United Kingdom National Health Services and in Germany. Eur J Health Econ. 4:287-289

19. Mang H., Bauer M. (2007). German refined-diagnosis related groups, version 2007: Die Abbildung der Intensivmedizin. Der Anästhesist 2:158-168

20. Markus L. (2003). The reform of hospital financing in Germany: an international solution? J Health Org and Mngt. 5:360-372

21. Matthias J. (2005). German health care system in transition: The difficult way to balance cost containment and solidarity. Eur J Health Econ. 6:183-187.

22. Meenan R.T., Maureen C.M.S., O'Keeffe-Rosetti C., Hornbrook M.C., Backman D.J., Goodman M.J., Fishman P.A., Hurtado A.V. (1999). The sensitivity and specificity of forecasting high-cost users of medical care. Medical Care. 8:815-823

23. Moerer O., Plock E., Mgbor U., Schmid A., Schneider H., Wischnewsky M.B., Burchardi H. (2007). A German national prevalence study on the cost of intensive care: an evaluation from 51 intensive care units. Crit Care. 3:R69

24. Nackel J.G.: Cost management for hospitals / John G. Nackel, George M.J. Kis, Paul J. Fenaroli. – Rockville, Md. : Aspen Publishers, 1987

25. Neilson A.R., Moerer O., Burchardi H., Schneider H. (2004). A new concept for DRG-based reimbursement of services in German intensive care units: results of a pilot study. Intensive Care Medicine. 6:1220-1223

26. Oostenbrink J.B., Rutten F.F.H (2006). Cost assessment and price setting of inpatient care in Netherlands. The DBC casemix system. Health Care Manage Sci. 3:287-294

27. Paul J.M.S., Jan B.O., Joost J.Z., Frans J.M.S. (2007). The risk of upcoding in casemix systems: A comparative study. Health Policy. 2-3: 289-299

28. Pietz K., Byrne M.M., Petersen L.A. (2006). A decision-theoretic approach to identifying future high-cost patients. Medical Care. 9:842-849

29. Pirson M., Martins D., Jackson T., Dramaix M., Leclercq P. (2006). Prospective casemix-based funding, analysis and financial impact of cost outliers in all-patient refined diagnosis related groups in three Belgian general hospitals. Eur J of Health Econ. 1:55-65

30. Rochell B., Roeder N. (2003). DRG – The new hospital reimbursement system for Germany. Urology [A]. 4:471-484

31. Roeder N., Glocker S., Marshall R., Rochell B., (2002). Prospects and limitations in depicting the cost of hospital services using Australian

DRGs: the Victorian hospital financing model. Das Krankenhaus. 5:388-397

32. Roeder N., Rochell B., Glocker S. (2002). Same DRG Service = Same Real Service? (I). Das Krankenhaus. 9:702-709

33. Roeder N., Rochell B., Glocker S. (2002). Same DRG Service = Same Real Service? (II). Das Krankenhaus. 10:794-800

34. Rosenberg A. L. (2002). Recent innovations in intensive care unit risk-prediction models. Curr Opin Crit Care. 8:321-330

35. Shook T.L., Sun G.W. Burstein S. Eisenhauer A.C., Matthews R.V. (1996). Comparison of percutaneous translumal coronary angioplasty outcome and hospital costs for low volume and high volume operators. Am j Cardiol. 5:331-336

36. Shreyögg J., Stargardt T., Tiemann O., Busse R. (2006). Methods to determine reimbursement rates for diagnosis related groups (DRG): A comparison of nine European countries. Health Care Manag Sci. 9:215-224

37. Stolk E. A., Rutten F.F.H. (2005). The “Health Benefit Basket” in the Netherlands. Eur J Health Econ. 6(Suppl 1):53–57

38. Stolker J.J., Heerdink E.R., Leufkens H.G.M., Clerkx M.G.M., Nolen W. A. (2001). Determinants of multiple psychotropic drug use in patients with mild intellectual disabilities or borderline intellectual functioning and psychiatric or behavioral disorders. 6:345-349

39. The World Health Report 2000: health systems: improving performance / World Health Organization. – Geneva : WHO, 2000

40. Thomas F., Alexandre L., Megali C., Elie A. (2005). Care at the end of life in critically ill patients: the European perspective. Curr Opin Crit Care. 11:616-623

41. van de Ven W.P.M.M., Ellis R.P., (2000), Risk adjustment in competitive health plan market. In: Handbook of health economics / ed. by Anthony J. Culyer … [Hrsg.]. – Amsterdam [u.a.] : Elsevier, S. 755-845

42. van de Ven W.P.M.M., van Vliet R.C., Lamers L.M. (2004). Health-adjusted premium subsidies in the Netherlands. 3:45-55

43. Wilke M.H., Höcherl E.F.J., Scherer J., Janke L. (2001). Introducing the new DRG-based payment system in German hospitals: a difficult operation? Experience and attempts at a solution from a surgery point of view. HEPAC. 2:79–85

44. Zuurbier J., Schaepkens F.: Cost accounting for the DBC case-mix system. Methodology and results, Proceedings of the 19th PCS/E Conference (2003)

Internet-link references

45. Agence Technique de l'information sur l'Hospitalisation (ATIH). http://www.atih.sante.fr/en/, retrieved on: 15.01.2009

46. Australian Refined Diagnosis Related Groups (AR-DRG) http://nis-web.fhs.usyd.edu.au/ncch_new/ARDRG.aspx, retrieved on: 15.01.2009

47. Bundesministerium für Arbeit und Soziales: Sozial-Kompass Europa. http://www.bmas.de/coremedia/generator/9836/sozial__kompass__europa__soziale__sicherheit__im__vergleich__cd__rom.html, retrieved on: 15.01.2009

48. Centre for Patient Classification System (CPK). DRG in Sweden. http://www.socialstyrelsen.se/en/about/epc/cpkeng.htm, retrieved on: 15.01.2009

49. DBC-onderhoud Manual validation version 2007 http://www.dbconderhoud.nl/, retrieved on: 15.01.2009

50. DRGs as a financing tool HOPE - European Hospital and Healthcare Federation Hope report on DRGs ans a financing tool 3 December 2006

HOPE, http://www.docstoc.com/docs/5739892/DRGs-as-a-financing-tool-HOPE-European-Hospital-and, retrieved on: 15.01.2009

51. Fallpauschalenvereinbarungen (FPV) 2005-2008. http://www.g-drg.de, retrieved on: 15.01.2009

52. G-DRG German Diagnosis Related Groups, Versionen 1.0 – 2009, Definitionshandbücher, Institut für das Entgeltsystem im Krankenhaus gGmbH (InEK gGmbH). http://www.g-drg.de, retrieved on: 15.01.2009

53. German Institute of Medical Information and Documentation (DIMDI). http://www.dimdi.de/static/en/index.html, retrieved on: 15.01.2009

54. ICN Workforce Forum. Overview Paper September 2003. Diagnosis related groups. www.icn.ch/forum2003report.pdf, retrieved on: 15.01.2009

55. NordDRG Users' Mannual version 2008. http://www.nordclass.uu.se/verksam/norddrgmanual/NordDRG_2008_SWE/, retrieved on: 15.01.2009

56. The Information System of the Federal Health Monitoring http://www.gbe-bund.de/, retrieved on: 15.01.2009

57. World Health Organization. World health statistic 2008. http://www.who.int/en/, retrieved on: 15.01.2009

CURRICULUM VITAE

PERSONAL PARTICULARS

NAME	Ms Rosminah Mohamed
ADDRESS (HOME)	Lot 454, Wakaf Siku, Jalan Kuala Krai, 15050 Kota Bharu, Kelantan. MALAYSIA.
ADDRESS (OFFICE & CORRESPONDENCE)	School of Health Sciences, Health Campus, Science University of Malaysia (USM) 16150 Kubang Kerian, Kelantan, Malaysia.
TELEPHONE NO	(6012) 2377 834 (Mobile) (609) 7444413 (Home) (609) 7663922 (Office)
EMAIL ADDRESS	rosminah@kb.usm.my
DATE OF BIRTH	7th. April 1964
NATIONALITY	Malaysian

ACADEMIC QUALIFICATION

SECONDRY

January 1977 – July 1982

Rewarded a Malaysia Certificate of Education (MCE) in 1982 and passed with 2nd. Grade.

TERTIARY

July 1982 - September 1986:

Graduated from University of MARA Institute of Technology (UiTM), Shah Alam, Selangor, Malaysia. Rewarded a Diploma in Microbiology on 27th. September 1986..

February 1993 - April 1996:

Graduated from Griffith University, Queensland, Australia. Rewarded a Bachelor of Science in Biotechnology on 12th. April 1996,

July 1998 - September 2001:

Enrolled as full-time master student (by research work) at Department of Community Health, Faculty of Medicine, Universiti Kebangsaan Malaysia (UKM). Master thesis titled “Acceptance, Willingness and Ability to Pay for Health care financing in Malaysia” was successfully done.

Rewarded a Master of Medical Sciences (Public Health), specializing in Health Economics on 7th. July 2001.

14th.February 2004

Sat for International English Language Testing System (IELTS) and generated the overall band score of 6.5.

1st April 2006 - now

Enrolled as full-time PhD student at Medinische Management, Medizinwcontrolling, Universitätsklinikum Münster, Westfalische-Wilhem Universität, Münster, Germany. PhD thesis titled “Determination of risk factors for high-cost cases within DRG systems of selected European countries” was successfully done.

OTHER QUALIFICATION:

November 1997 Rewarded a Diploma in Translation from Dewan Bahasa dan Pustaka, Kuala Lumpur.

EMPLOYMENT HISTORIES

July 1989 to December 1990

Occupation: Laboratory Technician (full time).

Employer: Pharmmalaysia Sdn. Bhd., manufacturer of pharmaceutical product.

January 1991 to January 1993

Occupation: Microbiologist.

Employer: Scanlab Sdn. Bhd., manufacturer of fine pharmaceutical product.

September 1996 to May 1998

Occupation: Research Officer.

Employer: Department of Biochemistry,
Medical Faculty,
Universiti Kebangsaan Malaysia (UKM).

Job description: Involved in research project titled "*Immune and Free Radical in Inflammatory Bowel Disease*", which was fully granted by the Government.

May 1998 to October 1999

Occupation: Research Officer.

Employer: Department of Community Health,
Medical Faculty,
University Kebangsaan Malaysia (UKM).

Job description: Involved in research project titled "*Option for health care financing in Malaysia*", which was fully granted by the

Government. This research project was also being a research thesis for my Master Degree.

November 1999 to December 2000

Occupation: Research Officer.

Employer: Psychiatry Department,

Kuala Lumpur General Hospital, Kuala Lumpur.

Job description: Involved in research project titled "*Cost-effectiveness Study in the management of schizophrenia at three levels of psychiatric care in Malaysia*", which was fully granted by the Government.

February 2001 to June 2003

Occupation: Assistant Programme Manager.

Employer: Medical Online Sdn. Bhd.

Level 8, KUB.Com.

Jalan Yap Kwan Seng,.

Kuala Lumpur.

Job description:

- Oversees all ongoing activities related to the development of Personalised Lifetime Health Plan (PLHP), maintenance of, and adherence to the government's policies and procedures also to ensure alignment between the content and application exist.
- Serves in a leadership role for the PLHP's Programme activities.
- Provides development guidance and assists in the identification, implementation, and maintenance of health information and procedures in coordination with healthcare management system provided by the Ministry of Health.
- Works with Telehealth Core Team Officers and public compliance Medical Officer to establish an intelligent home-based and clinic-based PLHP Programmes.
- Conduct related ongoing knowledge acquisitions monitoring activities in coordination with the MOH compliance and operational assessment functions.

- Works with the key departments, and committees to ensure the content of the PLHP programme has and maintains appropriate privacy and confidentiality consent, authorization forms, and information notices and materials reflecting current practices and requirements.

- Oversees, directs, delivers, or ensures delivery of initial training and orientation to training staffs.

- Establishes work distribution to the Assistant Managers and to ensure all issues concerns, requirements, and responsibilities are addressed.

- Works cooperatively with MOH Officers in overseeing patient rights to inspect, amend, and restrict access to protected health information when appropriate.

- Establishes and administers a process for receiving, documenting, tracking, investigating, and taking action on all complaints concerning all PLHP aspects.

- Reviews all system-related health information for Wellness Care Plan throughout the programmed network to ensure alignment between the content and application, and acts as a liaison to the Software Development Team.

- Works with departmental personnel involved with any aspect of release of PLHP, to ensure full coordination and cooperation under the organization.

July 2003 till now

Occupation: Lecturer.

Employer: School of Health Sciences,

Health Campus,

Universiti Sains Malaysia (Science University of Malaysia),

Kubang Kerian, Kelantan.

Job description:

- Giving lectures to student enrolled at School of Health Sciences.

- Taught subjects are Health Economics (Convener), Health Insurance, Telehealth and Thinking Technique (Convener) as an additional university subject that is compulsory to all first year students.

- Supervision for the final year student on their selected research thesis.
- Developing new programme for the school.

PROFESSIONAL SKILS

Research and Development:

- Develop method for product analysis.
- Design method for both microbiological assay and biochemical test
- Design method for clinical trial and non-clinical trial.
- Participate on research development in the manufacturing stages.
- Developing, planning and handling community survey

Analysis:

- Analysis of the raw material in process and finished products and retained product (stability test).
- Advice technician in the process of manufacturing stages.
- Operating different scientific instruments such as HPLC, Dissolution machine, Karl Fisher Titration, Spectrophotometer and etc.
- Analysis and interpret statistical data.
- Reporting formal report, precise and design project.

Computer:

- Word Processing.
- Statistical Software SPSS.

PERSONAL CHARACTERISTIC

- Analytical
- Enjoy challenges.
- Innovative.
- Willing to learn new skills and technologies.
- Possess initiative.
- Working autonomously as well as part of the team.
- Reliable.
- Ability to communicate with people at different ages and nationalities.
- Liasing with staffs from management to shop level.
- Conducting discussion with various departments.

INTEREST AND HOBBIES

- Reading.
- Travelling.
- Listening to music.
- Singing.
- Cooking.

SOCIAL ACTIVITIES

- Malaysian representative of Griffith University International Students Society.
- Member of Australian Society for Biochemistry and Molecular Biology.
- Committee member of Community Health Association, Medical Faculty, UKM.

COMMUNICATION

Able to speak, read and write in both Bahasa Malaysia and English.

PUBLICATION AND PRESENTATION

- Rosminah M. (1999). Option for health care financing in Malaysia: A survey in East Malaysia. Paper presented at Medical Symposium, Medical Faculty, Hospital UKM, Cheras, Kuala Lumpur (4^{th}. – 10^{th}. July).

- Rosminah M. (1999). Option for health care financing in Malaysia: A survey in Penisular Malaysia. Paper presented in 33^{rd}. Malaysia-Singapore Congress of Medicine, Sunway Lagoon Resort Hotel, Petaling Jaya, Selangor, Malaysia (18^{th} – 22^{nd} Aug).

- Rosminah M. (2000). Willingness to pay for health care financing in Malaysia. Paper presented in Medical Symposium, Medical Faculty, Hospital UKM, Cheras, Kuala Lumpur (24^{th} – 25^{th} June)

- Rosminah M. (2002). Personalised Lifetime Health Plan: What is in the pipeline for the public and healthcare System in Malaysia. Malaysian Journal of Public Health and Medicine. Vol. 2 (Sup.1).

- Rosminah M. (2004). Option for health care financing in Malaysia: A survey in East Malaysia. Malaysian Journal of Public Health and Medicine. Vol. 4 (Sup.1).

REFEREE

1) Professor Dr. Zainul F. Zainuddin.

   Dean,

   School of Health Sciences,

   Health Campus,

   Universiti Sains Malaysia,

   16150 Kubang Kerian, Kelantan, Malaysia

2) Professor Dr. Syed Mohsin Syed Sahil Jamalullail
   Deputy Dean of Academic,

   School of Health Sciences,

   Health Campus,

   Universiti Sains Malaysia,

   16150 Kubang Kerian, Kelantan, Malaysia.

3) Professor Dr. Syed Mohamed Aljunid Syed Junid.
   Head of Community Health Department,

   Faculty of Medicine,

   Hospital Universiti Kebangsaan Malaysia,

   Bandar Tun Razak,

   Kuala Lumpur.

Abschließende Erklärung

Ich versichere hiermit, dass ich meine Dissertation zum “Determination of Risk Factors for High-Cost Cases within DRG systems of selected European Countries” selbständig und ohne fremde Hilfe angefertigt habe, und dass ich alle von anderen Autoren wörtlich übernommenen Stellen wie auch die sich an die Gedankengänge anderer Autoren eng anlehnenden Ausführungen meiner Arbeit besonders gekennzeichnet und die Quellen zitiert habe.

Münster, den 09 Mai 2009