The Suitability of a DRG Casemix System in the Maltese Hospital setting

Abstract

The healthcare system in Malta is financed through global budgets and healthcare is provided free at the point of use. This paper is a first attempt to examine the feasibility of introducing a Diagnosis Related Groups casemix system for Malta, not necessarily for payment and funding purposes, but as a tool to help describe, manage and measure resource use. This is particularly challenging in view of the constraints and characteristics of a small state country. The study evaluates the applicability of the MS-DRG (Version 27.0) Grouper to describe acute hospital activity on the island. The classification of 151,615 admissions between 2009-2011 resulted in 636 DRG categories. Around half of these DRGs accounted for 99% of the total activity at the hospital, while 296 DRG categories had fewer than 15 cases over the period. Patient length of stay is used to explain resource use and the Coefficient of Multiple Determination obtained was of 0.19 (improving to 0.25 when a number of trimming algorithms were applied). A good proportion of the resulting DRGs had a Coefficient of Variation, which indicates a low degree of variability within the obtained DRG groups. This presents good evidence to support the introduction of a DRG system in Malta particularly in view of the recent drive towards more public-private partnerships and legislation on cross-border patient treatment.

Keywords: Casemix; DRGs; Hospital; Length of Stay; Malta

1. **Introduction**

The ability to measure the outcome of health care is critical to improving the effectiveness, efficiency and accountability of any health care system. Hospitals are deeply rooted in the political and administrative organisation of their country and typically account for the majority of spending by Government within the health care sector. Diagnosis Related Groups (DRGs) may help policy makers obtain an estimate of the activity undertaken within the hospital. This can help to better understand and measure the output of the hospital entity.

The multi-product nature of hospital output is a major factor to be dealt with when defining hospital activity. Classes of patients with similar clinical attributes and similar processes of care provide the necessary framework to aggregate patients into case types or *products* which entail the use of similar resources. DRGs are a management tool which views the delivery of health care as a service, indeed as a production process in which outputs (health care episodes) are delivered to consumers (patients).

The primary focus of this paper is the measurement of output in the Maltese health care sector through the use of a DRG casemix system. This will assist policy makers to assess and adopt the appropriate policy guidelines to ensure the sustainability of the continued provision of free health care services. By applying DRGs in this context, the findings of the study will also contribute to the debate of the relevance of such systems when applied to small countries which may have quite particular hospital characteristics. While recognising the limited availability of published work on the connection between country size, health systems and their outcomes, the broader question of constraints and opportunities of small countries has been extensively analysed by a number of authors. (1, 2)

To date, there has not been a study on the application of a DRG casemix classification system to health care activity in Malta. The majority of countries which introduced DRG systems as part of their reform initiatives have imported a pre-existing casemix system from another country - even though it may not have fully reflected their own health care practice patterns [3]. It is, typically, only later that countries decide to refine the implemented casemix system to better reflect their own health care system.

The results presented in this paper show that there is a good basis for recommending the introduction of a DRG based system to describe the hospital output activities in the Maltese health care system. On this basis, it may serve as a tool for the better measurement and management of resources across the health sector in this context.

2. Background

The motives underlying the introduction of DRG systems, as well as the particular design features of the systems, vary greatly across countries [4]. Such motives continue to evolve following the introduction of the DRG system, and may shape their development [5, 6]. Once DRGs are introduced, their primary use within most health care systems is for benchmarking purposes and to commission health care services. In later years, the aims evolve, with DRGs being used as an internal resource management tool to assess and monitor the impact of casemix changes within hospitals. In most countries today, DRGs serve as a basis for running prospective payment systems. The provision of health care systems, their historical background and the cultural environment within which they operate, have impacted the manner in which DRG systems are implemented worldwide. Within the setting of global budgets (as was the case with most European countries) the introduction of DRGs was mostly directed towards cost containment, achieving fairness and efficiency [7, 8]. DRGs are a flexible tool that can be adapted to support different country needs and health care system characteristics, be they tax-based, insurance-based or even financed through budgeting practices or contracting. Geissler et al., [9] stress the importance that a DRG system should take into account various dimensions: patients and service providers; payers (if they exist); and, possibly of society at large. Furthermore, given the expected complexities in the implementation of a DRG system, the benefits of such a system on the overall health care structure may only be achieved gradually over a number of years.

Casemix is defined by Anderson [10] as a system that “groups individual cases into a smaller number of case types so that the cases within a given group are homogeneous and the case types themselves are heterogeneous from other groups in some meaningful way”. Patients within a clinical group are expected to have reasonably consistent resource consumption levels and such levels are expected to differ from those of other groups. DRGs, in turn, are a tool which describes the number and type of treated patients in a hospital setting. According to Zhiping et al. [11], a casemix system must have three important characteristics: clinical meaningfulness, resource use homogeneity and a manageable number of classes. The DRG system is the most well-known casemix system, designed to group together acute inpatients, who are similar clinically and who have a similar pattern of resource use. The formulation of DRGs would encourage administrators to view the use and costs of hospital services along product lines based on DRGs and, in so doing, to provide information on whether resources used for particular episodes of care are in line with what is expected for an average case within a particular DRG group. DRG-based systems have now been implemented worldwide, including in many European Countries [8] with the aim of increasing transparency of hospital performance and resource consumption thus achieving greater efficiency by encouraging appropriate care and discouraging unnecessary care [3,11,12].

In countries where the inpatient sector is dominated by the public sector, and where most health sector workers are on fixed salaries, the incentives of introducing DRGs tend to differ from most others based on funding and payment objectives [3]. Scheller-Kreinsen et al., [3] highlight three main reasons for the introduction of DRGs in such a setting: increased transparency, greater efficiency and effectiveness and supporting in-hospital management. DRGs provide the information to help identify cases which could be judged as being relatively 'in line with the norm' in comparison with cases for which treatment is less efficient in terms of resource use.

The introduction of a DRG system has led to a number of benefits within the various health care systems in which they were introduced, in particular: reducing waiting times, increasing activity, stimulating provider competition and facilitating patient choice of hospital, controlling costs, improving transparency in hospital facilities and harmonising payment systems [13-16]. There is broad agreement in academic and policy circles that the introduction of DRGs also affects healthcare provider behaviour [3]. The introduction of DRGs has led to an increased level of activity in the short term, which, in turn, results from the fact that the introduction of DRGs provides an incentive for shorter hospital LOS periods [13-15]. Busse et al., [17] balances the gains from DRG use (namely those of generating valuable information on costs, casemix and better cost control per diagnosis), against the problems (namely those resulting from cream skimming, up-coding or DRG creep, cost shifting and quality skimping) [14, 18-22]. Case mix planning, or choosing the ideal composition and volume of patients in a hospital, ensures success in the efficient use of resources in a hospital [23].

Malta has an integrated health care service, organized at a national level with one main acute general hospital which provides specialised, ambulatory, inpatient care and intensive care services [24] for the entire population. The Maltese health care system is characterised by its universal coverage of a comprehensive set of services. The public health system is the main provider of health services on the island and the Ministry for Health is responsible for provision, setting of standards and regulation of the system [24]. Health services in Malta are provided freely by the state at the point of use. The total expenditure on health as a percentage of GDP is of around 8%, two-thirds of which are state financed, funded primarily by general tax revenue through a system of global budgets [24]. There are no user charges or co-payments for any part of the health care system and consultants working at the public hospital are engaged as government employees, paid on a salary grade scheme. The various public health facilities are treated as cost centres within one Ministry and each of the facilities is funded through an annual budget allocation. Entitlement to public health services is universal.

The financing of the system and the provision of the services have, to date, been primarily the responsibility of the state. This is slowly changing to a more mixed approach, as the provision of private care is gaining in size and importance. This private sector complements the provision of public health services, especially in the area of primary care. It is market-driven, with various autonomous and independent providers in various areas of medicine [24]. Public-private partnership agreements are also becoming increasingly common.

Given the geographical characteristics of Malta and particularly its relatively small size, the main hospital (under consideration in this study) caters for all the needs of the population, with the exception of some cases that require particular treatment or which are uncommon enough to be referred to specialized centres abroad. It would be neither cost-effective nor economically feasible to conduct such treatment locally. Within this context the Government of Malta (and the two main political parties on the island) are committed to keeping health care free at the point of delivery and it is the Government's intention to improve resources and ensure that they are managed efficiently [27].

As mentioned, developments over the most recent years show a drive towards more public-private partnership agreements whereby the responsibility for the management of some of the health care services would now shift to the private sector. This drive creates a need for better categorisation of hospital activity, particularly in view of Government's enhanced role of active purchaser and commissioner of hospital services. Within this integrated health system there is no clear purchasers-provider split. The breath of coverage for treatment in view of the increasing number of foreign patients on the island is also an issue of priority [24]. The requirements and obligations of the patients' rights and cross-border health care directive has put further pressure on the need to set out a publicly available list of tariffs upon which one could determine the eligibility for re-imbursement rates for cross border treatment [25,26]. It is a major challenge of the current health care system to ensure the sustainability of the system, developing the necessary mechanisms to adequately measure quality and outcomes while adapting to the new realities being faced by the most recent developments in the Maltese economy.

*3. **Data and methods***

This study uses patient level data provided by the Clinical Performance Unit of Mater Dei hospital for the years 2009-2011. Three different datasets, namely i. the Surgical and Operations Register; ii. the Admissions and Transfers Discharge Database; and iii. the Hospital Activity Analysis Database, were employed. These were integrated at patient level using an encrypted patient ID code. A mapping algorithm was used to map hospital activity data to the requirements of the MS-DRG (Version 27.0) Grouper software. Data (up to a six level digit diagnosis code), based on the ICD-10 classification system of the World Health Organisation (WHO) and procedure codes (up to three coding levels), based on the ICD-9-CM classification system served as the main inputs for the Grouper.

Data for diagnosis codes was initially converted from the ICD-10 general coding structure to the more specific ICD-10-CM structure. A number of assumptions, informed by the recommendations of the clinincal performance unit experts within the hospital, needed to be made, particularly given the lack of required detail in the available ICD-10 database. A backward mapping algorithm (General Equivalence Mapping (GEM)) provided by the Centers for Medicare and Medicaid Services (CMS) of the US government was applied to obtain data in the ICD-9-CM coding structure required by MS-DRG Grouper. The final dataset employed 151,615 patient cases.

Data based on episodes of inpatient care (individuals who have been given a bed at the hospital) was extracted for the following categories at patient level: admission and discharge date, age, sex, diagnosis and procedure codes and discharge status. Patients admitted for day cases for which the LOS would be recorded as zero were also included. DRGs are formed as follows: All possible diagnoses were first assigned into 25 mutually exclusive Major Diagnostic Categories (MDCs) identified by the Grouper to reflect the part of the body organ system affected. Cases with at least one operating room procedure are referred to as *surgical* and those with no procedures are treated as *medical* cases. In turn, these are characterised by the principle diagnosis for which patients are admitted. Grouping continues by assigning cases from the appropriate MDC categories to the particular DRG groups within each MDC based on those patient characteristics and comorbidities expected to impact on resource consumption patterns.

Resource-use was proxied by the Length of Stay (LOS) variable. In the absence of adequate cost-accounting data, the LOS variable is relatively easy to extract, well standardised and generally reliable and relevant as a physical measure of hospital resource [5, 28, 29, 30, 31, 32, 33].

The treatment of outlier cases in Malta's context is of prime relevance given the relative small size of the health care sector and the likelihood that a considerable amount of DRG categories would only comprise relatively few observations. Lichtig [34] and Reid et al., [35] identify a number of reasons related to the existence of outliers, including data errors, unusual combinations of clinical conditions, hospital-acquired complications and misadventures. Outliers ought to be valued differently from inliers [35] and Cots et al., consider that their presence would lead to a mean value of resource use which is not representative of the particular DRG group [36]. There is, therefore, a case for dealing with outlier observations causing much of this disturbance.

Only hospital stay outliers are considered in this study. Following the removal of cases considered by the management of the hospital as 'extreme' cases, whereby the LOS exceeded the 60-day mark, two trimming methods were chosen from various formulations adopted in the literature [34-35, 37-38]. These were applied to the DRG groups generated by the Grouper software. The first method is based on the distribution of the elements that make up the DRG group, attempting to make the arithmetic mean of the group more robust , in turn, two variations are applied in this study, namely the GM2 (Geometric mean + 2* standard deviation) and the GM3 (Geometric mean + 3* standard deviation methods). The second group of trimming methods is based on the interquartile range, whereby a multiple of the range between the 25^{th} percentile and the 75^{th} percentile is added to the 75^{th} percentile (referred to in this study as the IR1.5 (75th Percentile +1.5*interquartile range), and the IR2.0 (75th Percentile +2.0*interquartile range) methods). This second trimming method, adopted by a number of studies [5, 39], and also used by British National Casemix Office and the Australia Department of Health and Family Service, is non-parametric in nature. This means that is makes no strong assumptions on the distributional form of the dependent variable, and the trim points are not distorted by extreme values. Given the characteristics of the dataset, particularly the smallness of the hospital, this study did not apply a lower trim point to the data and only considers DRG groups composed of more than 15 cases over the three year period. Trimming at the lower end would have resulted in deleting LOS data on patients that are very important for the overall understanding of LOS patterns in the hospital at large.

The performance and adequacy of the MS-DRG Grouper to describe heterogeneity in LOS *between* DRG classes and homogeneity in LOS *within* DRG classes is evaluated by using the Coefficient of Multiple Determination (R^2) and the Coefficient of Variation (CV) statistics. The homogeneity of the DRG groups adds to the robustness of the DRG design. A CV value of zero is an indication that the group has no variance from the mean, while a *CV* greater than 1 is an indication of heterogeneity within the group. Fischer [40] and Palmer et al., [41] conventionally take a *CV* of less than 1 as an indication of a DRG with an acceptable degree of variation. This criterion is also applied in other studies [30, 31, 42, 43] to assess the performance of the DRG classification structure. The extent to which variation of LOS occurs between casemix groups, rather than within them, determines the strength of the grouping system. The R^2 provides a measure of the extent to which the DRG system explains variations in resource-use, based on the characteristics of the individual patient. The closer the ratio to 1, the more of the total variance is said to be explained by the variance between groups as opposed to variance within groups. This is thus an indication that the groups are relatively heterogeneous (between one another), as is required.

An OLS based regression model is used to explain the variation in resource-use. Most LOS distributions are asymmetric, usually with a long right tail and some very large observations [30]. The OLS method requires that the assumption of normal distribution of the error term holds. Hence the emphasis of the analysis shifts to the trimmed data, after the treatment of such outliers. This trimming and the removal of extreme cases significantly contributes towards the attainment of distributional properties which are more in line with the requirements of the OLS method [41].

A high R^2 is an indication that the DRG classification explains a significant proportion of the variation in LOS. The explanatory power of the DRGs, represented by the R^2, compared to that obtained in other studies seeks to evaluate the appropriateness of introducing a casemix system within a health care setting. R^2 values estimated for the different MDC categories created by the Grouper software show that variations are registered both across DRG classifications and for different MDCs. Averill et al., [11] highlight that there is a systemic variation in R^2 across MDCs reflecting the fact that LOS is more predictable in some MDCs (such as the circulatory system) and less predictable in others (such as mental health). The R^2 results obtained for the different MDC categories, are compared to similar results in the literature to gauge the adequacy of the DRG casemix system in such a context.

4. ***Results***

The classification of the 151,615 cases using MS-DRG resulted in 636 different DRGs, of which approximately 55% accounted for 99% of the total activity generated in the hospital. Further analyses showed that around 2% of the DRGs represented approximately 31% of the activity at the hospital. There were 296 DRGs with fewer than 15 cases each over the three-year period (1,481 patient cases in total). The ALOS for all hospital activity stood at 4 days. Out of these, only 31 DRGs (with fewer than 15 cases each) had an ALOS shorter than 4 days, indicating that most of these cases are complex ones which absorb a significant amount of hospital resources to be treated. DRGs with few episodes are harder to interpret as utilisation measures obtained for them are subject to relative sample variation that is not reduced by the law of large numbers [42].

Patients with very large LOS were treated as extreme cases and were removed for analytical purposes. As a result the ALOS fell to 3.63 days. In total there were 519 cases that reported a LOS in excess of 60 days. Approximately 44% out of the total cases accounted for short stay patients (0 or 1 day). When excluding such cases, the ALOS goes up to 6.7 days. Around 60% of the cases treated in the hospital had an ALOS of fewer than or equal to 2 days.

The presence of outliers in the dataset is due to a number of factors, such as the age of the patient, case severity, the availability of discharge to other institutions, and the social circumstances of the patients admitted to hospital. Information on the ALOS obtained following the application of the trimming methods including the percentage of outlier cases which were trimmed is given in Table 2.1. A universal trim applied to the data for cases with a LOS in excess of 60 days results in an ALOS of 3.8 days.

Table 2.1: Analysis of outlier cases by different trimming methods

Trimming method	No. of trimmed cases	ALOS	% of outlier cases
universal >60 days	519	3.8	0.3
GM2	7788	2.9	5.1
GM3	4553	3.2	3.0
IR1.5	15141	2.8	10.0
IR2.0	12709	2.9	8.4

Source: Analysis of MS-DRG Grouper output.

The IR1.5 method yielded a trim of around 10% to the data. This is in line with the guidelines provided by Palmer and Reid [41]. As a result the ALOS for the whole hospital fell to 2.8 days, or by around 25%, implying that dealing with such outliers would lead to a reduction of around 1 day from the ALOS within the whole hospital. This represents a considerable saving in terms of resource use.

The results presented in Table 2.2 show that, after the removal of extreme cases and those DRG groups with 15 cases or less,, 42% of the remaining DRGs have a *CV* less than 1. When the IR1.5 trimming method was further applied to the data, the proportion of DRGs with a *CV* of less than 1 rose to 85%, this being the highest proportion compared to the other trimming methods. The lower the variation within the grouped DRGs, the better the performance of the classification system (41). This showcases the ability of the Grouper to produce homogeneous groups.

Table 2.2: Proportion of DRGs with a CV<1 using different trimming methods

Partial trimming	42%
IR 1.5	85%
GM2	78%
GM3	70%
IR2.0	82%

Source: Analysis of MS-DRG Grouper output.

The effect of trimming, especially by using the IR1.5 method, resulted in sizeable changes in the CV of the different DRG groups, helping to reduce the CV values by a significant amount. In the absence of trimming, the DRG classification serves to explain 18.6% of the variation in resource use as measured by LOS. Trimming cases with a LOS greater or equal to 61 days improved the R^2 to 21.1% and, further trimming by using the IR1.5 method, resulted in a further improvement in R^2 to around 25%. Table 2.3 presents the variation in the number of trimmed cases resulting from the use of the different trimming methods applied. This table also shows that the R^2 statistics obtained are relatively similar.

Table 2.3: R^2 under different trimming methods

	All cases	<60 days	GM2	GM3	IR1.5	IR 2.0
R^2	0.186	0.211	0.258	0.236	0.243	0.235
No of Cases	151,615	151,095	143,624	146,859	136,271	138,703

Source: Analysis of MS-DRG Grouper output.

The resultant trimmed R^2 values measure both the performance of the Grouper in categorising cases into DRG groups as well as the characteristics of the patients trimmed. The results obtained suggest that the extra cases being trimmed under the IR1.5 are cases which should be removed from the dataset as they are not contributing to the performance of the classification system in terms of explaining resource use. Based on the above results, it can be concluded that the DRG classification can explain close to 30% of the total variation in LOS and therefore of resource-use between cases across the hospital. Further support of this conclusion was obtained by analysing variations in R^2 across the different MDCs, an analysis which highlighted variations within different case specialties within the hospital.

Table 2.4 shows the degree of variance within each MDC category (defined in the Appendix), based on the allocation of cases to DRGs under different trimming scenarios. The percentage of cases trimmed varied between MDC categories. When all cases were taken together, an R^2 of around 19% was obtained. This highlights the fact that a significant proportion of cases within each MDC exhibited resource allocations which varied from the expected average of the particular MDC group.

The trimming process yielded higher R^2 values in the majority of the MDCs analysed. There was a significant percentage point increase in R^2 for a number of MDC categories (14, 20, 21, 4, 5, and 16) after applying the IR1.5 trimming method. The removal of trim points led to a higher level of homogeneity within the group and higher levels of heterogeneity with the other groups as manifested by the improvements in the R^2 values.

Table 2.4: R^2 by MDC categories under different trimming scenarios

MDC	All cases	Partial Trimming[1]	Full Trimming[2]	% of cases trimmed (full)[3]
	%	%	%	%
All	18.6	21.1	25.6	18.7
0	12.0	19.9	18.0	25.4
1	9.2	16.5	20.0	16.2
2	10.3	10.3	1.4	25.8
3	24.0	31.8	40.9	30.2
4	30.0	45.4	60.3	13.8
5	19.7	34.0	47.2	15.0
6	13.6	25.2	31.1	15.4
7	32.7	43.5	53.5	9.9
8	25.3	34.8	42.5	23.9
9	5.3	14.7	14.3	20.3
10	26.1	37.7	43.7	13.1
11	13.6	31.1	38.1	21.1
12	17.9	34.5	46.7	20.4
13	19.5	39.6	48.3	18.1
14	35.2	40.6	64.2	16.8
15	39.1	52.3	58.5	11.7
16	31.2	36.5	51.9	18.5
17	19.5	28.5	22.0	20.7
18	28.8	40.3	51.5	17.0
19	36.5	58.1	63.8	25.4
20	19.5	26.8	55.6	20.2
21	14.1	26.9	48.4	11.7
22	45.7	47.9	48.9	9.1

23	4.5	17.2	8.7	23.0
24	45.2	n/a	n/a	n/a
25	48.5	40.1	n/a	n/a

n/a represent values that cannot be calculated given the small amount of cases within such MDCs.
[1] Represents trimming of cases with more than 60 days LOS only.
[2] Represents trimming of cases with more than 60 days LOS, those with less than 15 cases within each DRG and using the IR1.5 method.
[3] Represents percentage of cases trimmed based on the full set of cases.
Source: Analysis of MS-DRG Grouper output.

An analysis of the R^2 by MDC category? makes it possible to gauge whether the performance of the hospital is consistent across all types of cases. More than 70% of the derived MDCs had an R^2 value higher than 0.4 after the trimming process. This indicates that, in most of the MDCs, the DRG classification can explain a significant part of the variation in LOS. For each of these MDCs, a low R^2 value was recorded even when the untrimmed data was applied - possibly indicating that, in such cases, the LOS variable might not be a good indicator of resource use.

5. *Discussion*

The values of R^2 obtained in this study were around 0.3 for LOS using trimmed data. The R^2 values obtained from untrimmed data were low (0.19) but this has to be viewed in line with the known quality limitations of the available hospital data. R^2 values also varied across the different MDC categories, with some categories reaching levels close to 0.6 once trimming had been performed. R^2 values based on untrimmed data may indeed be more than 20 percentage points lower after outliers are removed [35, 39].

The R^2 reported in this study compares well to that reported by Zhiping et al., (2004) in a Chinese hospital (0.12), using the Australian Refined DRGs (AR-DRG). Other studies by Closon & Roger (1989) report an R^2 value of 0.42 using Belgian data applied to the Health Care Financing Administration DRG (HCFA-DRG) Grouper software, while Casas & Tomas

(1993) report R^2 values of around 0.4 using data from Ireland, Portugal, Switzerland and Spain.

Updating current coding practises in order to introduce a DRG system would serve to improve on the current available data - which clearly lacks coding detail. A more detailed and accurate collection of data process, including better recording diagnosis and procedures undertaken on each patient, would help in the classification of illness severity and mortality risk, while also contributing to more efficient ways of using hospital resources.

The success of a DRG system heavily depends on the quality of the coded data and the setting out of a well-defined purpose for current coding work. The development of a Casemix classification system is driven by socio-political, cultural and technical factors [44]. Such development is influenced primarily by the intended scope and use of the planned classification system, the underlying population size and the quality and depth of the available coded data [45]. It may be concluded that the specificities of the Maltese health care sector could be better gauged with an improved coding practice.

Indeed, among the priorities identified in Azzopardi-Muscat et al., [24] is the strengthening of the health information system in order to support improved monitoring and evaluation of the health care system. It is also the view of the European Commission, in its country report for Malta [44], that there is an immediate need for improvement in data collection on expenditure, resources and care utilisation, and in the methods used for carrying out of evaluations of quality of care. The limitations in terms of data collection cannot but be acknowledged [2] and the established WHO Small Countries Health Information Network aims to address this issue [24]. The introduction of a DRG system can therefore be viewed as a possibility to improve resource utilisation and address sustainability [47] within the context of the country specific recommendations issued by the European Commission. The current drive within the Maltese health sector towards more public-private partnerships agreements creates additional pressure for better categorising of hospital activity in view of Government's increasing role of active purchaser and commissioner of hospital services.

The likely success of a DRG system should be viewed in relation to three main parameters identified by Fourie et al., [12]; the cost of health care and the efficiency with which it is provided, the quality of care, and the equitable access to care. Careful consideration to each parameter would be crucial, in the process of making a DRG decision. Particular consideration must be made of the prospect that quality of care might be sacrificied to achieve a reduced LOS - leading to higher readmission rates or to a shift in costs to other sectors of the health care system [17]. Other studies report lower efficiency levels following DRG implementation [12, 48, 49]. There is also a concern in relation to the impact which a DRG system could have on health-care practitioners in the clinical setting and whether professional standards will be affected [12].

The setting up of a DRG casemix system would certainly ensure that policy makers have an additional tool which could be used to better manage resource-use. The improvement in the data collection process would be another gain to the health care system arising from the implementation of the DRG system. Furthermore, the new needs of the health care system, particularly in respect of the treatment of cross-border patients and the increasing number of public-private partnership arrangements could be facilitated once a DRG casemix system is introduced.

6. **Conclusion**

This study makes a first attempt at examining the relevance of using the MS-DRG grouper to describe hospital activity in Malta. The results show that the *CV* and the R^2 coefficients obtained provide a suitable basis for recommending the use of DRGs in the Maltese health care system. This study concludes that the MS-DRG Grouper software can be applied to the currently available data for the Maltese health care sector with relatively good results. Policy makers require accurate information on hospital activity to manage limited resources and monitor health care providers behaviour effectively (Ghaffari et al., 2008) and the introduction of a DRG classification system can serve to explain variation in hospital resource-use along different product lines, helping in the control and monitoring of resource use within the health care sector.

However, the introduction of a casemix system within a country is an administratively burdensome and technically complex process [51] requiring a change in the political and cultural setting of the hospital services. The process of introducing a DRG casemix system can be particularly demanding, in the context of Malta given the constraints and challenges posed by the small size of the country and of its health care system. The most recent organisational challenges faced by the Maltese health care system are in terms of the newly set public–private partnership agreements and the legislation governing cross-border patients. These challenges have created an urgent need for resource tools, such as the introduction of DRGs, to improve the management and control of hospital resources.

The effectiveness of the introduction of a DRG system depends on the various institutions and organisational conditions within the health system and the process of introducing a DRG casemix system is in itself a dynamic developmental process [9, 51]. Considerable care should be taken in the interpretation of the results given the relatively small size of the dataset used in this study. A more detailed analysis of the outlier cases and their impact on ALOS and resource use would further improve the understanding of hospital output. Indeed, this study has shown that trimming options do affect the results and that other factors might have to be controlled for to fully understand differences in resource utilisation within hospital DRGs.

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