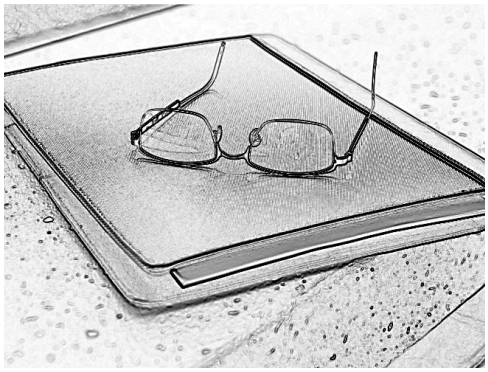

CASE-MIX ANALYSIS ACROSS PATIENT POPULATIONS AND BOUNDARIES: A REFINED CLASSIFICATION SYSTEM DESIGNED SPECIFICALLY FOR INTERNATIONAL USE

A WHITE PAPER BY:

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ABSTRACT

This paper describes the structure and features of the **3M™ International Refined-DRGs (IR-DRGs)** and assesses the validity of a new approach to standardizing the definitions of hospital inpatient and ambulatory services.

The clinical researchers at **3M Health Information Systems** recognize countries need DRGs capable of describing services, placing a value on those services, and supporting the use of both performance and quality indicators and measurements.*

In the international setting, it is also important to recognize that countries:

- Require a patient classification system that captures features unique to the country
- Must be able to compare one country with another
- Encourage the provision of care in an ambulatory setting, whenever it is medically appropriate
- Need to adjust for differences in patient severity of illness

For these reasons, 3M Health Information Systems has designed new IR-DRGs that:

- Use technologies that can help facilitate localization for individual countries
- Are "code independent" (i.e., provide the same results in classifying patients, regardless of the coding systems in use), making international comparisons possible
- Describe both inpatient and ambulatory encounters in one seamless system
- Consistently apply the concept of severity adjustment to better describe relative resource consumption based on individual patient characteristics

* Based on seminal works by Robert Mullin, MD, and John S. Hughes, MD (PCS/E Conference Proceedings, Washington, DC, October 2003).

The worldwide information revolution has catalyzed improvements to hospital data systems using case-mix analysis for decision support in resource utilization and healthcare funding arrangements. Essential to this effort is the use of a sophisticated system for classifying and evaluating complex healthcare information.

Healthcare decision-makers require a means of making relative comparisons of the services and resources patients consume and their corresponding quality and performance. These decision-makers also prefer a single patient classification system that can encompass a wide variety of coding systems and clinical practices in both inpatient and ambulatory settings. Such a system:

- Allows for accurate benchmarking and utilization assessment
- Provides an accurate basis for healthcare funding and budgeting

Significant shifts in managing healthcare delivery are occurring worldwide. Increasing numbers of non-government-owned delivery systems are providing health care to populations that were either previously managed by or excluded from government-funded national health programs. Economic pressures are forcing all of these delivery models to describe, in a uniform fashion, resource utilization and outcome patterns to better manage these resources while also measuring improvements in the quality of care. [1]

[1] Mullin, R. Utilization Review Based on Practitioner Profiles. *Journal of Medical Systems*. 1983; 7(5): 409–412.

As more governments and other entities make decisions about providing health care, the need for healthcare information increases, along with the realization of how important it is to fully utilize **Diagnosis Related Groups (DRGs)** or other classification systems when developing appropriate, common measures of hospital activity. An appropriate system relevant to a country's specific needs is required to categorize the patients these healthcare systems manage.

Issues

A statistically valid and clinically coherent system must be employed to:

- Aggregate patient diagnosis and/or treatment episodes that are similar in their resource consumption
- Explain variations in resource use

Classification systems developed for the United States and other countries can be difficult to adapt for areas where the coding systems in use differ from the coding sets used to develop the systems. Such systems are limited in their ability to fully meet the needs of other countries. Currently, numerous coding and classification systems are used worldwide. While many countries have adopted the **World Health Organization's International Classification of Diseases 10th revision (WHO ICD-10),** many countries have also developed or modified their existing procedure coding systems.

To facilitate intra-country and across-country profiling of patterns and costs of treatment, an inpatient classification system should reflect utilization and local clinical practice patterns for all patients treated. **The Centers for Medicare and Medicaid Services (CMS) DRG system** reflects the utilization of services and clin-

ical practice patterns in the care of elderly patients in U.S. hospitals. This system is inadequate as a classification scheme for assessing patterns and service costs of services incurred in treating non-Medicare patients. [2]

[2] Averill R, Muldoon J, Vertrees J, Goldfield N, Mullin R, Fineran E, Zhang M, Steinbeck B, Grant T. The Evolution of Case-mix Measurement Using Diagnosis Related Groups. 3M Health Information Systems Research Report, May, 1998.

All-Patient DRGs (AP-DRGs) were developed to classify the non-Medicare population. AP-DRGs created additional DRG categories for neonates, pediatric patients, and patients with Human Immunodeficiency Virus (HIV). Further refinements to the AP-DRG system included the addition of the concept of **Major Complications and Comorbidities (MCC).** Although they have been adapted for use in other countries, AP-DRGs were originally designed for use in the United States to classify the non-elderly population in the state of New York. Country-specific requirements and worldwide advances in healthcare technologies have created the demand for new and more refined generations of DRGs.

Given the shortage of patient-specific, coded data from many countries that are required to build these systems, it was necessary to adapt classification systems primarily developed for use in the United States and other countries. A number of countries have since made significant investments in collecting patient-specific data, using coding systems such as ICD-9, ICD-9-CM, or ICD-10 for diagnosis coding, some with minor modifications for use in their country. However, a common procedure coding system is still not widely used, so countries continue to adapt existing systems or develop country-specific procedure codes.

As the use of various coding systems increases, patients who exhibit similar clinical and resource consumption characteristics—regardless of the country they are treated in—need to be classified in a uniform and consistent way. As a result of the increased availability of reliable data, the information derived from the data needed to develop an international classification system has reached a point of quantity and quality that allows this goal to be achieved. However, numerous problems occur when a system originally developed for one country is adapted for another country where a different coding system is used.

Ideally, a single classification system specifically designed for use with these various coding systems could resolve these issues. As countries continue to shift from ICD-9 to ICD-10, the ideal classification system would also group a patient into the same DRG regardless of the coding system used. This would make the process of change much easier for hospital managers.

Answers

IR-DRGs build upon key design advancements of both the AP-DRGs and the **3M™ APR DRG (All Patient Refined DRG) Classification System.** For the ambulatory component, IR-DRGs align with the **3M™ Ambulatory Patient Group (APG) Software** developed by 3M Health Information Systems for CMS. CMS later adapted APGs for payment purposes into the **Ambulatory Payment Classifications (APCs).**

IR-DRGs were designed not only for use as part of a funding system, but also for budgeting, outcomes analysis, benchmarking, performance measurement,

and utilization assessment. In addition, IR-DRGs can compare resource usage across facilities and regions and support local and national health system management. IR-DRGs incorporate the concept of severity adjustment through the use of multiple levels of **Complications and Comorbidities (CCs)** applied to all base patient groups.

The concept of "refinement" in DRG systems is not new. "Refined" DRGs were first developed in the United States. The term "severity adjustment" refers to adjustments to the base DRGs that enhance their ability to explain the resources required to treat patients in a particular DRG. Although these DRGs perform well when applied to United States data and the ICD-9-CM coding system they were designed for, they are difficult to adapt for use in other countries where different coding systems or variations are used.

The advanced sophistication of these systems within the confines of the ICD-9-CM coding system and their ability to include "refinements" make them flexible yet difficult to use across other coding systems. "Code mapping" is often used to compensate for the differences, but this approach can lead to records that are incorrectly grouped. Such errors occur because mapping itself cannot reconcile the dilemmas of the one-to-many, many-to-one, many-to-many, and one-to-none relationships encountered in mapping different or modified systems.

Including severity adjustment in inpatient DRGs is an important characteristic that enhances the clinician's ability to use DRGs as a communication tool. For the ambulatory component, accompanying minor or major comorbidities are used for procedural DRGs, while a potential severity-adjustment based on length of consultation is used for non-procedural (medical) ambulatory DRGs.

As a result, the IR-DRGs incorporate explicit severity-adjustment as an integral part of their design. IR-DRGs are designed to conform to ICD-10, ICD-9-CM, and ICD-9, as well as accommodate country-specific modifications and procedure coding systems. The Refined DRGs (R-DRGs), AP-DRGs, APR DRGs, and IR-DRGs are the only inpatient DRG systems that uniformly adjust for severity across all patients.

Details

As a new generation of classification system, the IR-DRGs are distinguished by the fact that they were designed specifically for—*not adapted to suit*—international health care. IR-DRGs were not designed for use in the United States. The first version of the IR-DRG grouper required several large data sets to develop and subsequently test inpatient IR-DRGs. Two base data sets from the United States were used consisting of **6.9 million** inpatient records each. However, the DRG groups were finalized using an international database containing **200,323** records from three countries.

The second generation of the IR-DRG grouper has been developed and tested using a 5 percent sample of all ambulatory and inpatient CMS claims, as well

as all claims from the state of Maryland, the only all-payer, episodes-of-care database with charges and length-of-stay data available in the United States. Additional large databases from Switzerland, Belgium, and Singapore were used to validate the results.

Using the same logic as AP-DRGs and APR DRGs, inpatient IR-DRGs have three severity subclass levels (1, 2, and 3) for most DRG assignments, based on the presence and severity of Complications and Comorbidities (without CC, with CC, and with Major CC). The levels denote patient resource consumption. The severity level subclass assignment of secondary diagnoses was accomplished by analyzing the effects of each possible secondary diagnosis and some principal diagnoses on the resource usage and assigning one of three levels to each diagnosis. Recognizing that currently most international data sets contain an average of less than two secondary diagnoses, the IR-DRGs do not use multiple CCs to assign the severity level. As a result, this system can help improve both the intra- and cross-country comparisons and case-mix analysis.

Customization

An international inpatient classification system should not only encompass a range of coding systems, but also simplify modification of the system for country-specific requirements. The system must accommodate customization as required by various countries, while also maintaining a level of consistency across countries. The integrity of the base DRGs that are the foundation of the new system permits comparability across countries. However, variations can be made to suit various international and national procedure coding customs and standards.

Construction and validation

The IR-DRGs consist of **263 base inpatient DRGs,** of which **109 are procedural/intervention DRGs** and **154 are medical DRGs.** Each of the 263 base inpatient IR-DRGs can have three subclass severity levels, totaling **789 possible inpatient DRGs.**

There are **237 procedural/intervention ambulatory IR-DRGs,** many of them part of a comorbidity subdivision rather than a severity subclass. As for the non-intervention, or medical ambulatory DRGs, there are **51 base DRGs** and up to **135 medical ambulatory DRGs,** if the optional severity layer is used. *Figure 1 (below)* summarizes the allocation of IR-DRGs across inpatient and ambulatory categories:

		INPATIENT	OUTPATIENT
PROCEDURE	BASE	109	237
	BASE WITH SEVERITY LEVELS	327	
MEDICAL	BASE	154	51
	BASE WITH SEVERITY LEVELS	462	135 (OPTIONAL)

The total number of IR-DRGs is **1,077** without the ambulatory medical severity layer, and **1,161** with the severity level. Also available are 14 error DRGs to expand the explanation of non-appropriate grouping (such as invalid diagnosis and procedure codes). The combined total (including error DRGs) of **1,175 IR-DRGs** is included in version 2.1 of the classification system.

Previous experience with AP-DRG international groupers made it obvious that the ICD-10 coding system would require changes in the base DRGs, depending on specific ICD-9-CM codes not available in ICD-10. Thus, IR-DRGs were modified to be compatible with both ICD-9-CM and ICD-10. This results in a system that assures a given patient will fall in the same IR-DRG regardless of the coding system used.

Each coding-system-specific version of IR-DRGs is a **native grouper** in which the grouper logic is expressed directly in terms of the specific diagnosis and procedure coding system used by the individual country. No mapping between coding systems is used. Using native codes to construct DRG definitions provides more coherent groupings.

Independence from reimbursement mechanisms

An essential feature of any classification system is the independence of the clinical classification scheme and the payment mechanism, which allows various financial and operational tasks to be performed. A DRG classification must strike a balance between the number of groups and the discriminatory power of its structure.

If a classification becomes more specific for reimbursement imperatives driven by heterogeneous vested interests, it may expand into many hundreds of additional incoherent inpatient groups. A classification may increase its explanation of costs and reduction of variance as commonly measured, but it will also lose its strength as a core grouping methodology. The need for systematic, coherent severity-level adjustment mainly based on comorbidities and other factors is well recognized.

Resource utilization measurements

Resource utilization varies monotonically across the severity levels in each IR-DRG. This monotonic progression is consistent across all base DRG severity levels for charges and length-of-stay (LOS) in the United States databases, and in the international databases for LOS in all base DRGs with a significant number of cases. A few exceptions were identified where local adaptation could easily be done.

Figure 2 (below) shows an example of this monotonic progression with a sampling of DRGs in MDCs 5 and 7.

IR-DRG #	DEFINITION	AVERAGE LOS	RELATIVE VALUE
054101	IM Acute Myocardial Infarction	2.33	.688
054102	IM Acute Myocardial Infarction w/CC	4.56	.970
054103	IM Acute Myocardial Infarction w/MCC	7.20	1.568
071111	IP Complex Biliary Tract Procedures	6.38	1.768
071112	IP Complex Biliary Tract Procedures w/CC	10.20	2.614
071113	IP Complex Biliary Tract Procedures w/MCC	17.40	4.820

Figure 3 (below) shows an example of progression of resource weights (average ambulatory visit has an RV of 1,00) for the ambulatory IR-DRGs.

IR-DRG #	DEFINITION DESCRIPTION	RELATIVE VALUE
022310	Complex Anterior Segment Eye Procedures	5.714
022320	Moderately Complex Anterior Segment Eye Procedures	2.055
022330	Non-Complex Anterior Segment Eye Procedures	1.257
063140	Complex Upper Gastrointestinal Endoscopy	2.403
063150	Non-Complex Upper Gastrointestinal Endoscopy	1.756
063160	Other Gastrointestinal Procedures	0.641

Case-mix analysis studies

In recent studies, the IR-DRGs show improved performance for case-mix analysis when compared to other prominent classification systems.

To identify an appropriate ambulatory classification system, **Peter Fontaine,** chief information officer and chairman of the Matrix Project (a large consortium of over 40 Belgian hospitals), compared outpatient procedure data grouped under both IR-DRGs and APR DRGs (Belgium's national inpatient classification system). His results showed that 307 IR-DRGs were required versus 457 APR DRGs for the same data set, meaning that almost 50 percent more APR DRGs were needed to group these procedure codes. Even when the APR DRG severity adjustments were removed, the number of additional groups required under the APR DRG methodology was still 20 percent greater than the IR-DRG grouping. [3]

Deniza Mazevska, as the Acting Director, Performance Analysis and Reporting Branch, New South Wales Health Department, Australia, compared IR-DRGs with AR (Australian Refined) DRGs. In her study, Mazevska wanted to identify a classification tool that could help:

[3] Fontaine P, Licoppe C, D'Andrea R. International-Refined (IR-DRG) versus 3M All Patient Refined DRG (APR DRG) to describe and predict costs of patients in 42 Belgium hospitals. Proceedings, WHO Family of International Classifications, Tokyo Meeting. http://www3.who.int/icd/tokyomeeting/documentlist (June 2005), P2-9.

- Reduce the wait time for elective surgeries
- Evaluate which cases could be switched from an inpatient to an ambulatory setting

Mazevska's findings concluded that IR-DRGs offered more "… 'compact' and clinically meaningful descriptions for elective surgery," and proved to be better predictors of resource requirements for treating the wait-list patients. [4] She also noted that IR-DRGs can be helpful to the clinician when considering the potential substitution of short stay or ambulatory treatment for an inpatient procedure.

[4] Mazevska D. Comparison of 3M International Refined (IR)-DRG and Australian Refined (AR)-DRG. Proceedings, WHO Family of International Classifications, Tokyo Meeting. http://www3.who.int/icd/tokyomeeting/documentlist (June 2005), P2-8.

Conclusion

Reviewing the evolution and relevance of this new International Refined DRG (IR-DRG) system demonstrates why existing approaches to comparing episodes of inpatient hospitalization and ambulatory patients are neither consistent nor predictive of resource use. Existing approaches can be replaced by a system designed specifically for international use that can also provide clinicians and healthcare managers with objective and reliable ways of measuring the severity and resource utilization of hospitalized and ambulatory patients worldwide. The IR-DRGs are clearly suited for international use and addressing the challenges of the international market.

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