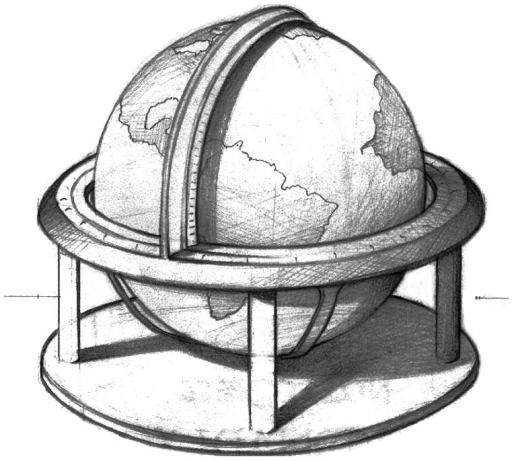

CASE-MIX ANALYSIS ACROSS PATIENT POPULATIONS AND BOUNDARIES: A REFINED CLASSIFICATION SYSTEM DESIGNED SPECIFICALLY FOR INTERNATIONAL USE

A WHITE PAPER BY:

— ROBERT MULLIN, MD
— JAMES VERTREES, PHD
— RICHARD FREEDMAN, PHD
— RUSS CASTIONI
— ANN TINKER, RN, MN

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 hospital product definitions.

The clinical researchers at **3M Health Information Systems** recognized that countries have these conflicting needs:

- A patient classification system that is unique to the country
- The ability to compare one country to another

Building on twenty years of experience in developing classification systems, 3M has designed the new IR-DRGs to provide the same results in classifying patients regardless of the coding system used. The new system allows a country to utilize IR-DRGs using its own diagnosis and procedure codes. Furthermore, the IR-DRGs refine the DRG system using the concept of severity adjustment to better describe relative resource consumption based on individual patient characteristics.

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 resources patients consume and their associated clinical courses. A single patient classification system that encompasses a wide variety of coding systems and clinical practices allows accurate bench-marking and utilization assessment, in addition to providing an accurate basis for healthcare funding and budgeting.

Significant shifts in the management of healthcare delivery are occurring around the world. There is an increasing number of non-government-owned delivery systems involved in 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 measuring improvements in quality of care.[1] As more governments and other entities are asked to make decisions regarding the provision of health care, there comes an increased need for healthcare information and the realization of the importance of developing appropriate, common measures of hospital activity to fully utilize **Diagnosis Related Groups (DRGs)** or other classification systems. An appropriate system that is relevant to a country's specific needs is required to categorize the patients these healthcare systems manage.

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

Issues

A statistically valid and clinically coherent system must be employed to aggregate patient treatment episodes that are similar in their resource consumption and to explain variations in resource use. Classification systems developed for the United States and other countries can be difficult to adapt where the coding systems vary from the coding systems used in the development of the systems. It is apparent that such systems are limited in their ability to fully meet the needs of other countries. Presently, numerous coding and classification systems are used worldwide. 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 (formerly Health Care Financing Administration, or HCFA) **DRG system** reflects the utilization of services and clinical 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, the AP-DRGs were originally designed to classify the non-elderly population in New York state in the United States. 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 solve these problems. 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 **All Patient Refined DRGs (APR-DRGs).** IR-DRGs were designed not only for use as part of a funding system, but also for budgeting, outcomes analysis, bench-marking, profiling, 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 Comorbid conditions (CCs) applied to all base patient groups.

This 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 often leads to records that are incorrectly grouped. Such errors occur because mapping itself cannot correct for the dilemma of the one-to-many, many-to-one, many-to-many, and one-to-none relationships that are encountered in mapping different or modified systems.

Including severity adjustment in DRGs is a very important characteristic that enhances the clinician's ability to use DRGs as a communication tool. Therefore, 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 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. Specifically, several large data sets were used to develop and subsequently test IR-DRGs. The two base data sets consisted of 6.9 million inpatient records each from the United States. However, the groups were finalized using a European database containing 200,323 records from three countries. The following list summarizes the source and number of cases contained in this database.

Country	Cases
United States	13,800,000
Belgium	32,214
Italy	121,826
Spain	46,283

Using the same logic as AP-DRGs and APR-DRGs, IR-DRGs have three severity subclass levels (1, 2, and 3) for most DRG assignments, based on the presence and severity of Complications and Comorbid conditions (without CC, with CC, and with Major CC). These levels denote patient resource consumption. The severity level subclass assignment of secondary diagnoses was accomplished by analyzing the effects of each possible secondary diagnosis 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. This system allows improved intra- and cross-country comparisons and case-mix analysis.

Customization

An international inpatient classification system should not only encompass a range of coding systems, it should also simplify modification of the system for country-specific requirements. It is also important for the system to accommodate customization as required by various countries while 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 319 base DRGs, 301 base DRGs with three subclass severity levels, nine base DRGs with no subclasses, three non-related operating room (OR) base DRGs with 3 subclasses, plus two error IR-DRGs with no subclasses for a total of 923 DRGs. Several base DRGs that were eliminated from the United States versions of DRGs (because these procedures were being performed in ambulatory care facilities rather than acute care hospitals) were returned to the IR-DRGs. For example, Carpal Tunnel Release, not included in the current U.S.-based systems, was incorporated into IR-DRGs because this procedure is so frequently documented as an inpatient procedure in international patient records.

Previous experience with AP-DRG international groupers made it obvious that the ICD-10 coding system would require changes in the base DRGs dependent 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 resulted 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.

Performance

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 European databases for Length of Stay (LOS) in all base DRGs with a significant number of cases. *Figure 1 (next page)* shows an example of this monotonic progression with a sampling of DRGs in MDC 4.

The IR-DRGs show improved performance for case-mix analysis when compared to both the CMS (formerly HCFA) DRGs and the AP-DRGs. Although they continue the evolution of the AP-DRGs, the IR-DRGs are clearly better suited for international use and better able to address the challenges of the international market.

U.S.			**Severity Level 1**		**Severity Level 2**		**Severity Level 3**	
IR-DRG	MDC	Description	TotChg1	count1	TotChg2	count2	TotChg3	count3
0436	4	Simple Pneumonia	$4,953	26917	$7,460	42920	$11,920	47796
0437	4	Chronic Obstructive Pulmonary Disease	$6,582	23748	$8,127	27543	$11,993	25606
0438	4	Asthma and Bronchiolitis	$4,261	35059	$5,649	18042	$ 9,938	4897
0439	4	Interstitial Lung Disease	$6,502	451	$8,627	1247	$13,013	1980
0440	4	Pneumothorax and Pleural Effusion	$5,776	3337	$8,202	4418	$13,065	5011
Europe								
IR-DRG	MDC	Description	alos1	count1	alos2	count2	alos3	count3
0436	4	Simple Pneumonia	9.03	1001	12.93	926	16.18	668
0437	4	Chronic Obstructive Pulmonary Disease	9.50	1127	12.46	915	16.46	1021
0438	4	Asthma and Bronchiolitis	5.87	608	9.41	177	14.30	69
0439	4	Interstitial Lung Disease	9.80	91	12.72	71	16.46	65
0440	4	Pneumothorax and Pleural Effusion	9.38	296	13.28	126	15.37	76

Figure 1. Summary data by severity level for medical respiratory IR-DRGs using U.S. and international data (charges are shown in U.S. dollars)

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 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 patients worldwide. ◆

3M

Health Information Systems
www.3M.com

Asia/Pacific
Leon Paff
Tel: 61 2987 56219
Fax: 61 2987 56219

Canada
Jim Stewart
Tel: 800 561 5115 ext. 3828
Fax: 905 602 6275

Europe
Anne Boucher
Tel: 49 2131 144244
Fax: 49 2131 144330

Latin America and South Africa
Russ Castioni
Tel: 301 476 7005
Fax: 301 476 7001

International (USA)
Rich A. Sanders
Phone: 801 265 4814
Fax: 801 263 3658

Published September 2002.