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Full Length Research Paper

Comparison between all patients refined diagnosis related groups with the centre for medicare and medicaid services diagnosis related groups

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Aim of the study was to compare the ability of the all patients refined diagnosis related groups (APR-DRG) with the centre for medicare and medicaid services diagnosis related groups (CMS-DRG) in predicting multidimensional impairment of elderly patients. Cases discharged from 20 geriatric units were grouped by the CMS-DRG and the APR-DRG. A comprehensive geriatric assessment (CGA) was performed using the activities of daily living (ADL), instrumental activities of daily living (IADL), short portable mental status questionnaire (SPMSQ), comorbidity index rating scale (CIRS), mini nutritional assessment (MNA), geriatric depression scale-short form (GDS-SF) and exton smith scale (ESS). Number of drugs at admission (DPA) and length of stay (LOS) were also recorded. CMS-DRG and APR-DRG relative weights (RW) were used for comparisons. 1273 patients were included. With increasing the APR-DRG-RW, a significant increase in the prevalence of impaired patients was found in ADL, IADL, SPMSQ, CIRS, GDS-SF and ESS. The CMS-DRG-RW subgroups showed a significant difference for MNA and GDS-SF. LOS was significantly different for both APR and CMS DRG. The number of CGA domains in which APR showed a more significant trend in disability when compared to CMS DRG demonstrates that the former was a better predictor of multidimensional impairment.

Key words: All patients refined diagnosis related groups (APR-DRG), centre for medicare and medicaid services diagnosis related groups (CMS-DRG), comprehensive geriatric assessment, elderly.

INTRODUCTION

The centres for medicare and medicaid services diagnosis related groups (CMS-DRG) classification system uses data contained in the discharge abstract form (DAF) to measure hospital case-mix, as the base for the prospective payment system. Previous studies reported that CMS-DRG classification system does not provide an accurate estimate of resource consumption in elderly patients (GIFA, 1996; Lynk 2001; Rosenthal and Landefeld, 2003), possibly because their consumption of

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healthcare resource is related not only to the severity of the clinical disorder leading to admission, but also to the global impairment of the individual (Chuang et al., 2003). This, in turn, may stem from a combination of biological, functional, psychological, pathological, and environmental factors, which can be correctly appreciated using the specific, multidimensional approach of comprehensive geriatric assessment (CGA) (Solomon et al., 2003).

Recently, the all patient refined-DRG (APR-DRG) system has been validated as a useful tool for estimating the impact of clinical severity on consumption of healthcare resources (Averill et al., 2002; Schein et al., 2008; Lavernia et al., 2009). Preliminary data suggested that this system is a good predictor of the severity of multidimensional impairment, as evaluated according to activities of daily living (ADL), instrumental activities of daily living (IADL), short portable mental status questionnaire (SPMSQ), mini nutritional assessment (MNA), cumulative illness rating scale (CIRS) and number of drugs taken (DPA) in elderly patients hospitalized in an acute geriatric unit (Pilotto et al., 2005). Multidimensional impairment is a very strong predictor of resource consumption and costs for the hospitalized elderly patients and should be used as a gold standard to test the fairness of patient classification system (Chuang et al., 2003). Relative weight (RW) evaluation assigned to each patients is easiest way to compare the ability of a classification system to evaluate the complexity of patients. No previous studies have compared APR-DRG with CMS-DRG systems in order to investigate which approach correlates better with multidimensional impairment of hospitalized older patients. This represents the aim of the present study.

MATERIALS AND METHODS

Study population

From February 01 to March 31, 2006, all patients discharged from 20 acute geriatric hospital wards in Italy (Appendix 1 for the complete list) were enrolled in the study. Inclusion criteria were: (1) Age ≥65 years; (2) a CGA completed on admission.

Discharge abstract form (DAF)

The Italian DAF is the minimum data set currently filled by physicians for each patient discharged from Italian hospitals. It includes the following data: Age, gender, date of birth; date and reasons for hospital admission, date of discharge, principal and up to five secondary diagnoses and up to six procedures performed during the hospitalization. Diagnoses and procedures were coded using the Italian translation of the International Classification of Disease, 9th revision, Clinical Modification (ICD-9-CM) used by Medicare in the United States for Fiscal Year 2002. The concordance between participating centres in the DAF compilation was assessed before the study by asking the investigators to compile the DAF for a sample of twenty medical records, and then comparing them with a standard compilation, performed by the coordinating centre. This preliminary procedure yielded a 99% agreement in DAF compilation.

The CMS-DRG system

A CMS-DRG was assigned to each case on the basis of the coded information available from the electronic DAF datasets. The CMS-DRGs system, 19th version, currently in use in Italy, measures case-mix according to 506 groups with the following characteristics: Similar type of patients in a given class from a clinical perspective; similar pattern of resource intensity within a given class; based on information routinely collected on hospital abstracts; manageable number of final classes and groups covering the entire range of patients seen in inpatient setting and mutually exclusive. A relative weight (RW), which measures the average cost of a DRG compared with the average cost of a reference DRG, was assigned to each case on the basis of its CMS-DRG. RW are computed yearly by the CMS and published on the Federal Register.

The APR-DRG system

The same information available in the electronic DAF datasets was processed with the APR-DRG grouper (Ver. 20). The APR-DRG taxonomy expands the basic DRG structure by adding to each base DRG two sets of four subclasses (that is, mild, moderate, severe, extreme), indicating the individual's severity of illness (SI) and risk of mortality (Averill and Goldfield, 1998). SI relates to the extent of physiological failure or organ system loss of function experienced by the patient, while risk of mortality relates to the likelihood of dying. SI subclasses are qualitative ordinal measures that are used to compare cases within the same APR-DRG. A comparison among different APR-DRGs can be biased when SI subclasses are applied alone, e.g., subclass 1 of hypertension is clearly different from subclass 1 of craniotomy. In order to allow the comparison among different APR-DRGs, a RW was assigned to each APR-DRG/SI combinations. RW were computed on the basis of the costs of 17,601,914 cases discharged from a representative sample of 2,382 hospitals located in 38 states of USA. A RW was assigned to each case in study on the basis of the APR-DRG SI descriptors.

Comprehensive geriatric assessment (CGA)

CGA was carried out on admission to evaluate the individual's clinical, functional, psychological, affective, and social status (Pilotto et al., 2008).

Clinical assessment included evaluation of drug treatment and of current pathologies, on the basis of history, physical examinatio, laboratory and instrumental tests, and previous clinical records.

Functional status was evaluated with the ADL (Katz et al., 1963) and IADL scales (Lawton and Brody, 1969), which define the level of independence in six daily personal care activities (bathing, toileting, feeding, dressing, urine and bowel continence and transferring from bed to chair) and eight instrumental functional abilities (use of telephone, travelling by car or public transportation, food or clothes shopping, meal preparation, housework, washing, medication use and management of money), respectively. Cognitive status was assessed with the SPMSQ, which briefly assesses orientation, memory, attention, calculation, and language (Pfeiffer, 1975). Depression was evaluated with the geriatric depression scale - short form (GDS-SF), a 5-item questionnaire inquiring perception of life. A score between 0 and 1 is assigned for each item. A total score of 2 or more suggests depression (Lesher and Berryhll, 1994). Comorbidity was measured with the CIRS (Linn et al., 1968), which defines clinical and functional severity of fourteen categories of illness: Heart diseases, hypertension, vascular and respiratory diseases, eye-ear-nose-throat dysfunction, upper and lower gastro-enteric diseases, hepatic, renal, urogenital, muscle-skeletal diseases, skin disorders, nervous system, endocrine-metabolic and psychiatric behavioural problems.

Nutritional status was explored with the MNA, an 18-item questionnaire encompassing anthropometric measurements (body mass index, mid-arm and calf circumferences), weight loss, dietary intake (number of meals, food and fluid intake, and feeding autonomy), and global assessment (lifestyle, medications, mobility, presence of acute stress, dementia and depression, self-rated health status and nutrition) (Vellas, 1999). The exton-smith scale (ESS), a 5-item questionnaire exploring physical and mental status, activity, mobility, and incontinence, was used to evaluate the risk of developing pressure sores. For each item, a score from 1 to 4 is assigned; a score of 16 or less is considerate to indicate an excess risk of pressure sores (Bliss et al., 1966). The number of drugs prescribed to the patients on admission (DPA) from the hospital was also recorded.

Statistical analysis

Statistical analysis was performed using the SPSS software (SPSS Inc. Chicago, IL, USA). Mean values are shown as mean ± standard deviation (SD). Pearson chi-square test was used to compare relative frequencies. For descriptive analyses, all cases were subdivided into tertiles according to the CMS-DRG and APR-DRG RW distribution, that is, (1) mild (CMS-DRG-RW <0.8 or APR-DRG-RW ≤ 0.6); (2) moderate (CMS-DRG-RW 0.6 to 1.1 or APR-DRG-RW 0.6 to 0.89); (3) severe-extreme (CMS-DRG-RW > 1.2 or APR-DRG-RW ≥ 0.9).

To allow comparison across these groups, continuous dependent variables, such as scale scores pertinent to CGA domains, DPA, and length of stay (LOS) were categorized into dichotomous variables. Cut-off points were set at: (1) Need for help in at least one ADL and two IADL for disability; (2) CIRS score greater than one for severe comorbidity; (3) SPMSQ score greater than 3 for cognitive impairment; (4) MNA below 24 for malnutrition; (5) GDS-SF score greater than two for depression; (6) ESS score lower than 16 for pressure sore risk; (7) five drugs for DPA, and (8) seven days for LOS.

P for trend from chi square test (categorical variables) or ANOVA (continuous variables) was considered to compare the prevalence of patients with abnormal CGA scores across DRG subgroups.

A p value ≤ 0.05 was used as the threshold for statistical significance.

RESULTS

A total of 1304 patients, were discharged from the 20 geriatric unit and considered eligible for the study. After the exclusion of 31 patients aged < 65 years, 1273 elderly patients (570 males, 703 females, mean age 81.5 ± 7.3 years, range 65-102 years) were enrolled.

The most frequent discharge diagnoses, described as APR-DRG codes, were heart failure (APR-DRG 194, 12.2%), chronic obstructive pulmonary disease (APR-DRG 140, 8.6%), respiratory failure (APR-DRG 133, 4.1%), degenerative central nervous system diseases (APR-DRG 42, 3.9%), transitory ischemic attack (APR-DRG 47, 3.4%), and pneumonia (APR-DRG 139, 3.4%).

On the basis of their APR-DRG RW, 330 cases were included in the mild APR-DRG RW group (Group 1), 402 cases in the moderate APR-DRG RW group (Group 2), and 541 cases in the severe-extreme APR-DRG RW group (Group 3). The proportion of men (40.1 vs 43.2 vs 48%; p = ns) and mean age (81.0 ± 7.3 vs 81.7 ± 7.6 vs 81.6 ± 7.1 years; p = ns) were similar across the three groups.

The prevalence of impaired patients increased significantly across the three APR-DRG subgroups. In particular, a significant increase was observed for the following variables: ADL (43.3 vs 52.6 vs 61.4%; p < 0.0001); IADL (64.5 vs 72.1 vs 72.7%; p < 0.01); SPMSQ (28.3 vs 33.7 vs 40.2%; p < 0.0001); CIRS (88.5 vs 91.5 vs 91.4%; p < 0.01), GDS-SF (84 vs 77 vs 69%; p < 0.0001) and ESS (26.3% vs 42.1% vs 50.6%; p<0.0001). The CMS-DRG-RW subgroups showed a significant difference only for MNA (46.6% vs 47.3% vs 48.1%; p<0.01) and GDS-SF (82 vs 73 vs 66%; p < 0.0001) but not for the other variables (Table 1).

DPA did not show any statistical difference across either APR-DRG (52.4 vs 58.3 vs 57.3%; p = ns) or CMS subgroups (50.3 vs 60.0 vs 57.7%; p = ns), whereas LOS different significantly across both APR-DRG (46.6 vs 56.6 vs 61.1%; p < 0.001) and CMS-DRG subgroups (46.7 vs 54.2 vs 63.0%; p = 0.0001).

The most frequent secondary diagnoses that influenced the APR-DRG SI descriptors assignment process and, consequently, the RW value were: Chronic obstructive pulmonary disease (80 cases), atrial fibrillation (59 cases), heart failure (40 cases), coronary artery disease (28 cases), pneumonia (20 cases), and acute respiratory failure (19 cases).

DISCUSSION

The main objective of this study was to evaluate if a refined DRG system could be a useful tool for grading the clinical and functional impairment of elderly inpatients, in order to identify patients at risk of high healthcare resource consumption. A recent study reported that hospital costs were higher in older medical patients dependent in some basic ADL on admission than in those not dependent on ADL, and that CMS-DRG based reimbursement did not account for this difference in costs (Chuang et al., 2003). The CMS-DRG classification is mainly based on resource intensity which is predicted by the diagnoses and procedures recorded in the DAF, without taking into account of age and comorbidity risk adjustment factors. Munoz et al. (1988) suggested that diagnosis-related group (DRGs) did not adequately compensate for patients with multiple complications and comorbidities in internal medicine. Moreover, the multifunctional impairment of elderly hospitalized patients were not depicted by CMS-DRG, as reported in two previous studies carried out in frail elderly patients (Berenson and Pawlson,1984; Jenks and Kay, 1987). Lang et al. (2007) demonstrated that malnutrition, walking difficulties and cognitive impairment were good predictors of the length of stay in French Hospitals. No previous prospective study however was carried out to evaluate the impact of the global impairment in elderly patients on the resource consumption intensity, as measured by a

Table 1. Percentages of impaired patients at each multidimensional evaluation domain ranked by All Patients Refined (APR) and Commission for Medicare Services (CMS) Diagnosis Related Groups (DRG) Relative Weight (RW) subgroups.

Domain	APR-DRG			p-Value	CMS DRG			p-Value
	Group 1	Group 2	Group 3		Group1	Group 2	Group 3	
ADL	43.3	52.6	61.4	<0.0001	43.1	60.1	56.0	ns
IADL	64.5	72.1	72.7	<0.01	63.0	79.0	68.8	ns
CIRS	88.5	91.5	91.4	<0.01	86.5	93.8	91.2	ns
MNA	48.3	48.6	46.2	ns	46.6	47.3	48.2	<0.01
SPMSQ	28.3	33.7	40.2	<0.0001	31.0	39.2	33.8	ns
GDS-SF	84	77	69	<0.0001	82	73	66	<0.0001
ESS	26.3	42.1	50.6	<0.0001	26.2	39.1	29.3	ns

APR-DRG subgroups: Group 1: RW (< 0.6) % impaired patients; Group 2: RW (0.6 to 0.89) % impaired patients; Group 3: RW (≥ 0.9) % impaired patients. CMS-DRG subgroups: Group 1: RW (< 0.8) % impaired patients; Group 2: RW (08 to 1.1) % impaired patients; Group 3: RW (≥ 1.2) % impaired patients.

discharge classification system. Moreover, no studies have compared APR-DRG with CMS-DRG classification systems in their ability to estimate global impairment of elderly patients.

Our previous study showed that the APR-DRG three-grade hierarchy of severity of illness was significantly associated with variables representing typical domains of multidimensional impairment in elderly patients, that is ADL, IADL, SPMSQ, CIRS and MNA (Pilotto et al., 2005). Unfortunately, a potential confounding factor in performing the analysis by aggregating into the same group of APR-DRG severity index patients with different clinical status was unavoidable. To overcome this bias, in the present study, we used APR-DRG RW to compare subgroups identified on the basis of a given level of severity (This approach made it easier to understand the difference between SI 1 of hypertension and SI 1 of heart failure.

The accuracy of APR-DRG is strictly related to the quality of the DAF compilation (Shen, 2003). In our study, the high level of concordance among the DAF coders observed before the beginning of the study (99%) supported the evidence that the DAF compilation accuracy was high and homogeneous. In this study, the APR-DRG system was found to be able to identify three groups of patients with a significant different multi-dimensional impairment, as assessed by CGA criteria. We observed that an increase in the APR-DRG RW categories was associated to a progressive significantly higher percentages of patients impaired in functional (ADL and IADL scores), cognitive (SPMSQ), nutritional (MNA), co-morbidity status (CIRS), risk of sores (ESS) and depression (GDS-SF) domains. Patients with high LOS, a well known proxy of costs, were also different among APR-RW as well as CMS-DRG subgroups. APR-DRG was significantly better than CMS-DRG in five of the seven variables considered, exploring different CGA domains.

We are aware that our findings are limited in that no direct measure of health consumption was collected. However, our findings indicate that the APR-DRG reflects the complexity and impairment in multiple domains (which strongly influence the burden of care) of older hospital patients better than the traditional CMS-DRG. Thus, application of this novel grouper can overcome the limitations of the CMS-DRG system, which - with some exceptions (Jenks and Kay, 1987) has been commonly reported not to compensate hospitals adequately for the acute care of the frail elderly (Berenson and Pawlson, 1984). Recent data showed that functional status remains a major predictor of costs for caring the elderly inpatients, even after adjusting for CMS-DRG RW (Chuang et al. 2003), whereas a multicentre European study on factors affecting discharge of older people from the hospital demonstrated the need of CGA also for case-mix systems to compare the risk adjusted length of stay (Campbell et al., 2005). Along the same line, other authors have shown that cognitive status and objective measures of physical functioning remain independent predictors of survival and functional outcomes of older, community-dwelling subjects even after adjusting for indexes of comorbidity (Di et al., 2006).

Although all the physician must be sensitive to the increasing problem of the scarce resources for caring, the elderly equitable hospital payment for these patients must be emphasized in order to maintain a fair quality in the care process.

The introduction in the Italian hospitals reimbursement system of a severity refined DRG system that could be related to CGA assessment zand could be the first step to make this payment system more equitable for the elderly acute care.

Conclusion

The APR-DRG system showed a better performance in

identifying meaningful subgroups of patients with multidimensional impairment if compared to CMS-DRG. We are aware that, with the progressively increasing age of hospitalized patients, new, more sophisticated systems are to be developed to improve hospital case-mix evaluation, by taking explicitly into account elements from the CGA. However, we believe that substitution of the CMS-DRG with the APR-DRG system is an immediately available way to improve equity in resource distribution even within the current, DRG-based prospective payment system, supporting hospital services which care for the most vulnerable and demanding older patients.

Abbreviations: ADL, Activities of daily living; **APR-DRG,** all patients refined diagnosis related groups; **APR-DRG-RW,** all patients refined diagnosis related groups relative weights; **CGA,** comprehensive geriatric assessment; **CIRS,** comorbidity index rating scale; **CMS-DRG,** centres for medicare and medicaid services diagnosis related groups; **CMS-DRG,** centre for medicare and medicaid services diagnosis related groups relative weights; **DAF,** discharge abstract form; **DPA,** number of drugs prescribed at admission; **ESS,** exton smith scale; **LOS,** length of stay; **GDS-SF,** geriatric depression scale-short form; **IADL,** instrumental activities of daily living; **MNA,** mini nutritional assessment; **SI,** severity of illness; **SPMSQ,** short portable mental status questionnaire.

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APPENDIX

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