Adaptive capacity of the Adjusted Clinical Groups Case-Mix System to the cost of primary healthcare in Catalonia (Spain): a observational study

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ABSTRACT

Objectives: To describe the adaptive capacity of the Adjusted Clinical Groups (ACG) system to the cost of care in primary healthcare centres in Catalonia (Spain); a observational study. BMJ Open 2012;2:e000941. doi:10.1136/bmjopen-2012-000941

Setting: Retrospective study (multicentres) conducted using computerised medical records.

Participants: All patients registered in the study centres who required care between 1 January and 31 December 2008 were finally studied. Patients not registered in the study centres during the study period were excluded.

Outcome measures: Demographic (age and sex), dependent (cost of care) and case-mix variables were studied. The cost model for each patient was established by differentiating the fixed and variable costs. To evaluate the adaptive capacity of the ACG system, Pearson’s coefficient of variation and the percentage of outliers were calculated. To evaluate the explanatory power of the ACG system, the authors used the coefficient of determination ($R^2$).

Results: The number of patients studied was 227,235 (frequency: 5.9 visits per person per year), with a mean of 4.5 (3.2) episodes and 8.1 (8.2) visits per patient per year. The mean total cost was €654.2. The explanatory power of the ACG system was 36.9% for costs (56.5% without outliers). 10 ACG categories accounted for 60.1% of all cases and 19 for 80.9%. 5 categories represented 71% of poor performance ($V = 78,887$, 34.7%), particularly category 0300-Acute Minor, Age 6+ ($N = 26,909$, 11.8%), which had a coefficient of variation of 139% and 6.6% of outliers.

Conclusions: The ACG system is an appropriate manner of classifying patients in routine clinical practice in primary healthcare centres in Catalonia, although improvements to the adaptive capacity through disaggregation of some categories according to age groups and, especially, the number of acute episodes in paediatric patients would be necessary to reduce intra-group variation.

ARTICLE SUMMARY

Article focus

- In health management, separating financing, purchasing and the provision of services requires more precise instruments and measurement of healthcare activity.
- The ACG Case-Mix System is a system of risk adjustment that classifies persons according to the diseases they present over a given period.

Key messages

- The ACG system is an appropriate manner of classifying patients in routine clinical practice in primary healthcare centres in Catalonia.
- Although improvements to the adaptive capacity through disaggregation of some categories according to age groups and, especially, the number of acute episodes in paediatric patients would be necessary to reduce intra-group variation.

Strengths and limitations of this study

- The greatest limitations of the study are related to the quality of the records and information systems.
- Without standardisation of methodologies in terms of patient characteristics and the number and measurement of variables, the results and their generalisability should be interpreted with caution.

INTRODUCTION

In health management, separating financing, purchasing and the provision of services requires more precise instruments and measurement of healthcare activity. Various countries are developing methods of per capita funding as a mechanism for allocating healthcare resources in a given region. The Adjusted Clinical Groups (ACG) Case-Mix System is a system of risk adjustment that classifies persons according to the diseases they present over a given...
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period. The main objective is to measure the degree of disease in patient populations according to different levels of morbidity.4 5

Classification systems for ambulatory patients, especially primary healthcare (PHC) patients, have not been widely used even in the USA, where they mainly originated. In addition, there is some uncertainty about the adaptive capacity of these instruments in health fields other than that for which they were designed. These classification systems relate the burden of disease, consumption of resources and the real costs of care.6–11
Therefore, studies aimed at improving knowledge of the relationships between these factors can provide valuable evidence.

In general, ACG are accepted as useful in our setting and their use is increasing in various areas. However, some ACG categories seem to have excess variability and therefore we decided to study the performance of each ACG category in PHC centres in Catalonia.6 12 13

The aim of this study was to identify the retrospective adaptive capacity and poorly performing categories of the ACG system according to the cost of care in various PHC centres in Catalonia (Spain) in daily clinical practice.

METHODS
Design and study population
We conducted a retrospective, multicentre study based on computerised medical records of PHC patients. All records were dissociated to ensure the confidentiality of the data. The study population consisted of all patients (N=310,255) assigned to 13 PHC centres in Catalonia belonging to four service providers. The patient population was predominantly urban, lower-middle class, with industrial occupations. All centres included provide universal free-at-the-point-of care healthcare with private provision of services in concert with the Catalan Health Service. All patients registered in the study centres who required care between 1 January and 31 December 2008 were finally studied. Patients not registered in the study centres during the study period were excluded.

Data retrieval and processing
Dependent variables were defined as the mean number of episodes and the direct costs of PHC. The independent variables analysed were age, sex, care provider and clinical service (family medicine (age ≥15 years) and pediatrics (age 0–14 years)). An episode or reason for consultation was considered as a care process equivalent to a diagnosis. The health problems diagnosed were coded using the International Classification for Primary Care (ICPC-2).14 A conversion (mapping) from ICPC-2 codes to ICD-9-CM was made by a working group (one documentalist, two clinicians and two technical consultants). Relationships between the ICPC-2 and ICD-9-CM were divided into three groups: (1) no relationship (ICPC-2 code with no equivalent in ICD-9-CM), (2) one-way relationship (one ICPC-2 code with a single equivalent in ICD-9-CM, the optimal situation) and (3) multiple relationships (one ICPC-2 code with several possible equivalents in ICD-9-CM).

The following measures were used to calculate overall morbidity: (1) the Charlson comorbidity index15 as an approximation of severity and (2) the individual case-mix index obtained using the ACG. The operating algorithm of the ACG Grouper V.8.2 (http://www.acg.jhsph.edu)16 consists of a series of consecutive steps that result in 106 ACG, which are mutually exclusive groups for each patient treated.

To construct an ACG, the age, sex and the reasons for consultation or diagnosis according to ICD-9-CM are required. The first stage groups the diagnoses of the ICD-9-CM in 32 Ambulatory Diagnostic Groups (ADG) (a patient may have one or more ADG), the second step groups the ADG into 12 Collapsed Ambulatory Diagnostic Groups, the third step transforms these into 25 Major Ambulatory Categories and finally these are transformed into an ACG category. At the end of the process, each patient is assigned to a single group with similar resource consumption. The application provides resource utilisation bands (RUB), with each patient being grouped into one of the five mutually exclusive categories according to their morbidity: 1. healthy users, 2. low morbidity, 3. moderate morbidity, 4. high morbidity and 5: very high morbidity).4 5

To measure the performance or adaptive capacity of each ACG category (intra-group variability of the total cost of care), we used: (1) the Pearson’s coefficient of variation (CV), in which a coefficient >100% was considered poor performance and (2) the percentage of outliers obtained through data refining of variables. The cut-off point (T) for outliers was established using the formula: $T = \frac{Q_3 + 1.5 (Q_3 - Q_1)}{2}$, where $Q_3$ and $Q_1$ are the third and first quartile of the distribution, respectively.

Use of resources and cost model
The design of the system of costs took into account the information requirements and degree of development of available information systems. The unit of care product used as the basis for the final calculation was the cost per patient treated during the study period. For each patient, we differentiated fixed costs and variable costs. The main fixed costs were staff (salaries and wages), purchases (drugs, medical supplies, etc), outsourced services (building repair and maintenance, professional services, etc) and a set of costs relating to structural services and centre management according to the General Accounting Plan for Health Care Centers. Fixed costs were allocated per visit (mean/unit: fixed costs/total number of visits). Variable costs per patient were calculated according to diagnostic petitions (laboratory, radiology, diagnostic or therapeutic, referrals to specialists and drug prescriptions). The tariffs used to calculate costs came from analytical cost-accounting studies (see table 1). Finally, the cost per patient was
Data confidentiality

According to Spanish law, being a retrospective design and because it is not investigated the effectiveness of any medicine, the study does not need specific approval from an institutional review board or the patient’s consent but instead required the dissociation of the data. The confidentiality of records according to the Organic Law on Data Protection (15/1999, 13 December) was respected by dissociating the data.

Data quality and statistical analysis

In a preliminary analysis, we carefully reviewed the medical records to observe their frequency and distribution and to search for possible errors in recording or coding. We performed a descriptive univariate analysis including mean values, SD, proportions and percentiles.

The normal distribution of variables was confirmed using the Kolmogorov–Smirnov test. In the bivariate analysis, we used the \( \chi^2 \) test, the Student t test, ANOVA, Pearson’s linear correlation and the Mann–Whitney–Wilcoxon non-parametric test. To evaluate the explanatory power of the ACG system, we used the coefficient of determination (R\(^2\)) obtained from the ratio intra-group variability/total variability (ANOVA). The analysis was made using the SPSS for Windows V.18 statistical package. Statistical significance was established as \( p<0.05 \).

RESULTS

A total of 227,235 patients were registered in the study centres in 2008 (86.5% in family medicine and 13.5% in paediatrics). Table 2 details the general characteristics of the patient population, the comorbidity and the total costs. Patients had a mean of 4.5 (3.2) episodes and 8.1 (8.2) visits per year. The percentage of men (51.1% vs 43.3%, \( p<0.001 \)) and visits (9.7 vs 7.8, \( p<0.001 \)) were higher in paediatric patients. The mean age of women was higher than that of men, 39.2 vs 37.8 (\( p<0.001 \)). The total cost was €118.7 million (93.3% for family medicine). Drugs were prescribed to 80.1% of patients. Fixed costs accounted for 29.1% of total costs and variable costs for 70.9% (including 47.5% on drug prescriptions). Therefore, the mean total cost per patient/year was €654.2 (851.7), €702.5 in family medicine and €344.6 in paediatric (\( p<0.001 \)). A total of 6.2% of patients were considered outliers, and after data refining, the mean unitary cost per year was €556.7. The association between the mean/unit cost according to age is shown in figure 1.

The performance (patient distribution) and adaptive capacity (intra-group variation in categories) of the ACG classification are shown in table 3. All patients were grouped in a category. However, no patients were grouped in 37 of the 106 categories, meaning that all patients were grouped in the remaining 69 categories. Furthermore, 61% of all patients were grouped in 10 categories and 80.9% in 19 (N=183,721, table 3). This distribution showed no significant differences according to the service provider. In 10 ACG categories, a poor

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Mean unit costs in 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health resources</td>
<td>Unit cost (€)</td>
</tr>
<tr>
<td>Health visit</td>
<td>23.62</td>
</tr>
<tr>
<td>Laboratory tests</td>
<td>22.70</td>
</tr>
<tr>
<td>Conventional radiology</td>
<td>18.84</td>
</tr>
<tr>
<td>Diagnostic tests/therapy</td>
<td>37.85</td>
</tr>
<tr>
<td>Referral to reference specialist</td>
<td>106.29</td>
</tr>
<tr>
<td>Drug prescriptions</td>
<td>RRPvat</td>
</tr>
</tbody>
</table>

Analytical accounting conducted for this study. RRPvat, recommended retail price including Value Added Tax.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>General characteristics of study: comorbidity and cost model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics</td>
<td>Total Patients N=227,235</td>
</tr>
<tr>
<td>General</td>
<td></td>
</tr>
<tr>
<td>Number of physicians</td>
<td>224</td>
</tr>
<tr>
<td>Number of episodes</td>
<td>1,020,606</td>
</tr>
<tr>
<td>Number of visits</td>
<td>1,834,326</td>
</tr>
<tr>
<td>Mean age, years</td>
<td>44.1 (23.7)</td>
</tr>
<tr>
<td>25 percentile</td>
<td>27.0</td>
</tr>
<tr>
<td>50 percentile</td>
<td>43.0</td>
</tr>
<tr>
<td>75 percentile</td>
<td>67.0</td>
</tr>
<tr>
<td>Sex (female)</td>
<td>55.6%</td>
</tr>
<tr>
<td>General comorbidity</td>
<td></td>
</tr>
<tr>
<td>Mean ADG</td>
<td>3.7 (2.2)</td>
</tr>
<tr>
<td>Mean episodes</td>
<td>4.5 (3.2)</td>
</tr>
<tr>
<td>Mean Charlson index</td>
<td>0.2 (0.6)</td>
</tr>
<tr>
<td>RUB</td>
<td>2.4 (0.8)</td>
</tr>
<tr>
<td>1</td>
<td>16.9%</td>
</tr>
<tr>
<td>2</td>
<td>31.0%</td>
</tr>
<tr>
<td>3</td>
<td>47.9%</td>
</tr>
<tr>
<td>4</td>
<td>3.8</td>
</tr>
<tr>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>Outliers (N=14,066)</td>
<td>6.2%</td>
</tr>
</tbody>
</table>

Mean/unit %

| Cost model (in euros)/year | |
| Fixed costs | 190.7 (193.3) | 29.1 |
| Laboratory | 51.9 (73.8) | 7.9 |
| Conventional radiology | 21.4 (34.1) | 3.3 |
| Complementary tests | 6.2 (19.6) | 1.0 |
| Referrals to specialists | 73.1 (117.3) | 11.2 |
| Drug prescriptions | 310.8 (681.2) | 47.5 |
| Total cost of PHC | 654.2 (851.7) | 100.0 |
| Cost of family medicine | 92.9% |
| Cost of paediatric medicine (0–14 years) | 7.1% |

Values expressed as mean (SD) or percentage. RUB, resource utilization bands; ADG, Ambulatory Diagnostic Groups; PHC, primary healthcare.
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Figure 1 Correlation of the cost of care according to age. $R^2$: coefficient of determination.

Performance (poor adaptive capacity) was observed (CV >100%, N=110,917, 48.8% of patients, table 3 and figure 2). The two categories with the highest CV were 1600-Preventive/Administrative (N=8527, 3.8%, outliers: 12.5%) and 1300-Psychosocial, w/o Psychosocial Unstable (N=3653, 1.6%, outliers: 10.7%).

We carried out a more-detailed analysis according to poor performance and the number of patients in each category. Table 4 shows the distribution of five ACG categories (making up 71% of poorly performing categories, N=78,887). Compared with the total of 69 categories (N=227,235), these five categories had a lower explanatory power (coefficient of determination, $R^2$) in episodes (44.3% vs 77.4%) and total costs (18.8% vs 36.9%), p<0.001. For refined data, the results were 46.4% vs 78.4% for episodes and 36.5% vs 56.5% for total costs, p<0.001. Category 0900-Acute Minor, Age 6+ (N=26,909; 11.8%) had a CV =139% and 6.6% of outliers and showed significant differences before and after data refining. Categories 0400-Acute Major (N=8160) and 1800-Acute Minor/Acute Major (N=9077) performed similarly. Category 4100-2-3 Other ADG Combinations, Age 35+, had the highest number of patients (N=28,864, 12.7%), with a high mean number of episodes (3.9 of total cases compared with 4.5 in outliers, p<0.001), resulting in increased costs in these patients. The $R^2$ of the five poorly performing categories was 34.7%.

**DISCUSSION**

This study determined the retrospective adaptive capacity of the ACG classification system according to the cost of PHC in Catalonia (Spain) in daily clinical practice, identifying 10 categories that performed poorly in the Catalan health system. In Catalonia, the use of capitation-based funding is still in its infancy compared with other European healthcare systems. The focus is on incorporating risk adjustment indicators in order to provide unbiased estimates of the expected costs of an individual patient in each health plan.2-17

There is abundant published evidence on the use and overall performance of the ACG classification, but evidence on categories that perform poorly is very limited.1-7,9,12,18-24 It is expected that persons with similar morbidity and demographic characteristics will have a similar use of resources. In this respect, the available empirical evidence shows that it is technically possible to find an adjustment formula to predict at least a portion of the variation in health expenditure per person and also that the highest predictive values are

**Table 3** Distribution of ACG categories with the most patients: variability of categories

<table>
<thead>
<tr>
<th>ACG Description</th>
<th>N</th>
<th>%</th>
<th>Cost*</th>
<th>CV</th>
<th>Outliers</th>
</tr>
</thead>
<tbody>
<tr>
<td>4100 2-3 Other ADG Combinations, Age 35+</td>
<td>28,864</td>
<td>12.7</td>
<td>776.3</td>
<td>107</td>
<td>6.5</td>
</tr>
<tr>
<td>0300 Acute Minor, Age 6+</td>
<td>26,909</td>
<td>11.8</td>
<td>169.6</td>
<td>139</td>
<td>6.6</td>
</tr>
<tr>
<td>4910 6-9 Other ADG Combinations, Age 35+, 0-1 Major ADGs</td>
<td>14,876</td>
<td>6.5</td>
<td>1624.4</td>
<td>67</td>
<td>4.5</td>
</tr>
<tr>
<td>2100 Acute Minor/Likely to Recur, Age 6+, w/o Allergy</td>
<td>11,867</td>
<td>5.2</td>
<td>304.7</td>
<td>91</td>
<td>5.3</td>
</tr>
<tr>
<td>4410 4-5 Other ADG Combinations, Age 45+, no Major ADGs</td>
<td>10,551</td>
<td>4.6</td>
<td>1025.4</td>
<td>74</td>
<td>5.3</td>
</tr>
<tr>
<td>4420 4-5 Other ADG Combinations, Age 45+, 1 Major ADGs</td>
<td>10,137</td>
<td>4.5</td>
<td>1336.2</td>
<td>79</td>
<td>4.6</td>
</tr>
<tr>
<td>0500 Likely to Recur, w/o Allergies</td>
<td>9,872</td>
<td>4.3</td>
<td>187.2</td>
<td>140</td>
<td>6.6</td>
</tr>
<tr>
<td>1800 Acute Minor/Acute Major</td>
<td>9,077</td>
<td>4.0</td>
<td>353.2</td>
<td>104</td>
<td>5.9</td>
</tr>
<tr>
<td>1600 Preventive/Administrative</td>
<td>8,527</td>
<td>3.8</td>
<td>229.5</td>
<td>215</td>
<td>12.5</td>
</tr>
<tr>
<td>0400 Acute Major</td>
<td>8,160</td>
<td>3.6</td>
<td>237.3</td>
<td>160</td>
<td>8.1</td>
</tr>
<tr>
<td>0900 Chronic Medical: Stable</td>
<td>6,319</td>
<td>2.8</td>
<td>506.7</td>
<td>114</td>
<td>6.2</td>
</tr>
<tr>
<td>3900 2-3 Other ADG Combinations, Males Age 18 to 34</td>
<td>5,877</td>
<td>2.6</td>
<td>341.7</td>
<td>117</td>
<td>6.0</td>
</tr>
<tr>
<td>3200 Acute Minor/Acute Major/Likely to Recur, Age 12+, w/o Allergy</td>
<td>5,785</td>
<td>2.5</td>
<td>525.0</td>
<td>89</td>
<td>6.3</td>
</tr>
<tr>
<td>2300 Acute Minor/Chronic Medical: Stable</td>
<td>5,756</td>
<td>2.5</td>
<td>612.6</td>
<td>95</td>
<td>6.3</td>
</tr>
<tr>
<td>3600 Acute Minor/Acute Major/Likely to Recur/Chronic Medical: Stable</td>
<td>5,575</td>
<td>2.5</td>
<td>1022.1</td>
<td>72</td>
<td>5.0</td>
</tr>
<tr>
<td>4310 4-5 Other ADG Combinations, Age 18 to 44, no Major ADGs</td>
<td>4,168</td>
<td>1.8</td>
<td>554.8</td>
<td>86</td>
<td>6.4</td>
</tr>
<tr>
<td>4920 6-9 Other ADG Combinations, Age 35+, 2 Major ADGs</td>
<td>4,089</td>
<td>1.8</td>
<td>2102.5</td>
<td>67</td>
<td>3.5</td>
</tr>
<tr>
<td>2800 Acute Major/Likely to Recur</td>
<td>3,659</td>
<td>1.6</td>
<td>351.0</td>
<td>102</td>
<td>6.9</td>
</tr>
<tr>
<td>1300 Psychosocial, w/o Psychosocial Unstable</td>
<td>3,653</td>
<td>1.6</td>
<td>340.4</td>
<td>175</td>
<td>10.7</td>
</tr>
</tbody>
</table>

Nineteen ACG categories contain 80.9% of patients (N=183,721). No patient was grouped in 37 ACG categories; ACG, Adjusted Clinical Groups (Code):* Gross cost (mean/unit in euros), CV: Pearson’s coefficient of variation; †: outliers: percentage of patients, cut-off: $T = Q_3 + 1.5 \times (Q_3 - Q_1)$, where $Q_3$ and $Q_1$ are the third and first quartiles of the distribution, respectively. Total sample: N=227,235, CV = 130.0%, outliers: 6.2%.
achieved by systems that incorporate diagnostic information.\textsuperscript{6} 21 25 This has been proven in our study since the number of episodes showed a greater explanatory power with respect to ACG categories than the total costs. Furthermore, data refining may lessen the weight of random factors in predicting expenditure, although it is known that no system of classification of patients into RUB explains all the variation in the use of resources.\textsuperscript{6 7 10 26}

In general, the Grouper requires a limited number of variables for each patient: age, sex and diagnosis (not necessarily correlated in time). This simplicity of use is compatible with the needs of PHC, which must work with large daily volumes of information, limited time for each patient, professional cooperation (doctors, nurses, social workers, etc) and repeated visits from the same patient. However, a greater degree of computerisation of PHC and the establishment of mechanisms for consensus between health professionals would be required to increase data quality and the consistency of records, especially in the identification of diagnoses.\textsuperscript{11 23}

The general results of the study (demographic variables (age and sex), case mix (morbidity) and resource use levels (RUB)) fall within the parameters expected in PHC in Spain. Furthermore, the distribution of patients within ACG categories is similar to the results obtained in other studies (60% of patients are grouped in 10 ACG categories) and stable over time.\textsuperscript{4 6 8 9 12 18}

This may be because the grouping works by binary combinations of ADG, regardless of the number of recurrences and the type of disorder.\textsuperscript{4 5} For example, a patient with one or more episodes of upper respiratory

\begin{table}[h]
\centering
\begin{tabular}{|l|c|c|c|c|c|}
\hline
\textbf{ACG categories (coding and description)} & \textbf{Total} & \multicolumn{2}{|c|}{\textbf{No outliers}} & \multicolumn{2}{|c|}{\textbf{Outliers}} \\
\hline
\textbf{Variables} & \textbf{N} & \textbf{Mean} & \textbf{N} & \textbf{Mean} & \textbf{N} & \textbf{Mean} \\
\hline
4100: 2-3 Other ADG Combinations, Age 35+ & 28864 & 26992 & 1872 \\
Age & 60.5 (14.8) & 59.7 (14.6) & 70.9 (12.8) \\
Episodes & 3.9 (1.3) & 3.9 (1.2) & 4.5 (1.5) \\
Total cost & 776.3 (828.2) & 620.3 (448.7) & 3026.1 (1504.4) \\
\hline
0300: Acute Minor, Age 6+ & 26909 & 25142 & 1767 \\
Age & 33.1 (16.5) & 31.9 (15.4) & 50.5 (22.1) \\
Episodes & 1.7 (1.1) & 1.7 (0.9) & 2.5 (1.4) \\
Total cost & 169.5 (236.5) & 125.2 (91.7) & 800.0 (554.3) \\
\hline
1800: Acute Minor/Acute Major & 9077 & 8538 & 539 \\
Age & 32.1 (19.8) & 30.8 (18.5) & 51.6 (27.1) \\
Episodes & 3.6 (1.5) & 3.6 (1.4) & 4.8 (2.3) \\
Total cost & 353.2 (366.2) & 288.7 (166.5) & 1374.2 (843.8) \\
\hline
0400: Acute Major & 8160 & 7503 & 657 \\
Age & 38.5 (18.2) & 36.6 (16.7) & 59.9 (20.6) \\
Episodes & 1.6 (0.8) & 1.5 (0.7) & 2.1 (1.1) \\
Total cost & 237.3 (379.5) & 158.3 (108.7) & 1139.1 (877.8) \\
\hline
3900: 2-3 Other ADG Combinations, Males Age 18 to 34 & 5877 & 5523 & 354 \\
Age & 28.1 (4.5) & 28.0 (4.5) & 28.7 (4.2) \\
Episodes & 3.3 (1.0) & 3.3 (1.1) & 3.8 (1.2) \\
Total cost & 341.6 (399.1) & 273.7 (154.1) & 1401.2 (1040.1) \\
\hline
\end{tabular}
\caption{Distribution of five poorly performing ACG categories according to age, episodes and cost}
\end{table}
Adaptive capacity of the Adjusted Clinical Groups Case-Mix System

A few years ago, misclassification of patients due to the complexity of the selection of diagnoses might have contaminated the comparison of costs between groups. However, strength of the study is that the large sample size could minimise these drawbacks. The ACG system was designed to measure the health status and medical resources consumed in a set of patients and, therefore, population-based studies of risk-adjusted capitation payments and the clinical management of PHC centres may be of considerable interest in Catalonia.

Conclusions

The ACG system is an appropriate manner of classifying patients in routine clinical practice in PHC centres in Catalonia, although improvements to the adaptive capacity through disaggregation of some categories according to age groups and, especially, the number of acute episodes in paediatric patients would be necessary to reduce intra-group variation.

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Contributors

AS-M, SV-V, RN-A, CV-F and AP-T planned the study. AS-M, RN-A and SV-V supervised the campaign registration, data entry and follow-up. AS-M was responsible for the statistical analysis with help from SV-V. AS-M wrote the first draft of the paper and has the primary responsibility for the final content. All authors contributed to and approved the final manuscript. AS-M is the head of the Catalan study.

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Competing interests

None.

Ethics approval

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