RUG-III and resource allocation: comparing the relationship of direct care time with patient characteristics in five countries

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Abstract

Background: resource use by different types of patients is of increasing interest to health care services all over the world. Case-mix systems that group together individuals with similar patterns of resource use have been developed to address these questions. Resource Utilization Groups version III (RUG-III) was developed in the USA to address the issue in the care of elderly people and has been validated in a number of countries.

Method: this paper synthesizes the results of RUG-III validation studies performed in the USA, Japan, Spain, Sweden and England and Wales, showing the consistency of the system in spite of different skill-mix and total time spent with patients. Data from the validation studies of five countries were compared. Percentage of time given by trained nurses and mean nursing time per patient was compared overall and between selected RUG-III groups.

Results: mean time per patient ranged from 84.4 min per day in Japan, to 155.6 min in England and Wales. Trained nurse time ranged from 7.5% of total time in the USA to 53.2% of total time in England and Wales. The inter-group relationship was very similar in all countries. The RUG-III system appears robust in a wide variety of settings and countries. Future research should address the relationship between skill-mix and total time spent with patients with respect to outcome and quality of care.

Keywords: case-mix, long-term care, nurse resource use

Introduction

Resource use by different types of patients is of increasing interest to health care services all over the world. As demands for health service resources increase, so will the interest in the relationships between costs and patient needs and between costs and quality of care. Case-mix systems that group together individuals with similar patterns of resource use have been developed to address these questions. These systems should make it possible to identify similar individuals cared for in settings with different resource inputs and/or different care delivery systems.

For elderly subjects, suitable systems need to be based upon factors such as physical and cognitive function rather than diagnoses and procedures as in diagnosis-related groups [1].

Resource Utilization Groups (RUGs) is such a system. The RUG system, now in version 3 (RUG-III), was developed in the USA as a result of widespread concern about quality and escalating costs of care in nursing homes. (Nursing homes in the USA accommodate post-acute, rehabilitation and long-stay patients.) RUG groups were formed using statistical techniques to group patients by the clinical characteristics which
best explained the differences in staff time spent with different patients. The application of strict criteria ensured that the resulting groups had not only statistical but also clinical meaning [2,3].

The system comprises seven main clinical groups devised as a hierarchy, ranked by cost. These groups are rehabilitation, extensive services, special care, clinically complex, impaired cognition, behavioural problems and reduced physical function. These main groups are further divided into subgroups on the basis of an activity of daily living (ADL) score that reflects the intensity of ADL dependency, receipt of certain types of care (including rehabilitation input from nurses) and the presence or absence of depression.

The groups at the top of the hierarchy represent clinical characteristics that were found to be associated with increased care costs. The ADL subdivisions within the hierarchy reflect the importance of physical function as a driver of cost. The contribution of cognitive function in the absence of other clinical characteristics is recognized in the impaired cognition group. This system explains greater than 50% of the variation in per diem resource use among US nursing home residents.

So attractive has been the RUG concept, that the system has been tested in a variety of settings in a number of countries to see whether the groupings found to explain variation in staff time in the USA did so in the countries in question. Validation studies of the RUG-II system have been conducted in the USA, Sweden and the Netherlands [2,5,6] and of RUG-III in the USA, England and Wales, Japan, Sweden and, most recently, Spain (G. Ljunngren, personal communication, [3, 4, 7, 8]). Studies conducted in the USA show that the relative amount of time spent by staff for patients with similar clinical characteristics (referred to as case-mix) remained the same in spite of very large differences in total staff time [9]. Variance explanation in excess of 50% found in the studies from the other countries would suggest that the system is robust in different care settings.

This paper synthesizes the results of RUG-III validation studies performed in Japan, Sweden, England and Wales and Spain, in order to demonstrate that this case-mix classification developed in the USA has universal applicability. It also focuses on the fact that, although the relative amount of care time spent may be the same according to the case-mix among these five countries, the absolute amount of time varies greatly as does the ratio provided by qualified nurses as opposed to aides (henceforth referred to as the skill-mix).

### Method

### Population

Data from the RUG-III validation studies are held in UMAAP (University of Michigan Assessment Archive Program), a computerized database at the University of Michigan [10]. Data from Japan, Sweden, England and Wales (referred to as UK below), Spain and the USA have been extracted from the interRAI database held on UMAAP. The studies in Spain and the USA were conducted in nursing homes that contained a mix of skilled (with rehabilitation) and unskilled (without rehabilitation) facilities and in Japan and Sweden in a mix of nursing homes and rehabilitation and long-stay hospital wards. The UK study was conducted in hospital-based geriatric services but data from the rehabilitation and long-stay wards only have been included in this paper. The methodologies for the evaluation studies were similar, with nurse-patient contact time recorded using the same timesheet system. The sole exception was the Spanish study, where care time was constructed from tasks specified in patients' careplans. These careplans were developed using the Plaisir assessment and careplanning system [11] which includes estimated time requirements for careplan interventions.

### Comparison of total staff time and proportion of trained nurse time

The total trained (registered nurse) and untrained (licensed practitioner nurse, care assistant and nursing aide) nursing time spent in direct patient care on individuals in the study groups was extracted from UMAAP. Total time per patient and trained nurse time as a percentage of total time were compared across the five countries.

Given that these data come from different types of institutions and the case-mix may have been different, case-mix-adjusted time was also compared. The staff resource use of a patient in a particular RUG group is expressed as a case-mix index (CMI). A CMI of 1 represents the average for a study population, a CMI of 1.5 represents 150% of the average and so on. Case-mix adjustment was achieved by applying the CMIs from the UK study to all five countries.

Table 1 shows the RUG-III groups chosen which would permit comparison of individuals with:

1. Different clinical characteristics and physically more dependent (SSB, CC1 and PD1).
2. Different clinical characteristics and physically less dependent (CA1 and PA1).
3. Similar clinical characteristics and different physical dependency (CC1 and CA1, PD1 and PA1).
4. Different cognitive function and low physical dependence (IA1 and PA1).

(See the illustration of the RUG-III hierarchy in Carpenter et al. [4] to locate groups.)

The number of groups suitable for inclusion in the study was limited by small sample sizes in the non-US countries, particularly Sweden. A criterion for selecting groups for comparison was that they should contain at
Table 1. Selected Resource Utilization Group (RUG-III) groups in descending order of technical complexity

<table>
<thead>
<tr>
<th>RUG-III group</th>
<th>Clinical characteristics</th>
<th>Activities of daily living</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special care (SSB)</td>
<td>Severe illness and intensive treatment</td>
<td>Dependent (score 14-16)</td>
</tr>
<tr>
<td>Clinically complex (CC1)</td>
<td>Less severe illness and less intensive treatment</td>
<td>Dependent (score 11-16)</td>
</tr>
<tr>
<td>Clinically complex (CA1)</td>
<td>Less severe illness and less intensive treatment</td>
<td>Low dependency (score 4-5)</td>
</tr>
<tr>
<td>Impaired cognition (IA1)</td>
<td>No severe illness, cognitively impaired</td>
<td>Low dependency (score 4-5)</td>
</tr>
<tr>
<td>Reduced physical functions (PD1)</td>
<td>No severe illness</td>
<td>Dependent (score 11-15)</td>
</tr>
<tr>
<td>Reduced physical functions (PA1)</td>
<td>No severe illness</td>
<td>Low dependency (score 4-5)</td>
</tr>
</tbody>
</table>

At least 15 cases, but an exception was made for Sweden where one group contained 11 (CA1) cases and one contained three (SSB) cases.

Data analysis

This study aimed to illustrate the staff time relationships between RUG groups in countries with different styles of elderly care service and demonstrate whether there was a similarity of distribution (rather than a difference). Mean nurse time (and standard deviation) spent with patient was compared for each country, as a whole and by the RUG-III groups selected.

Results

Total staff time and proportion of trained nurse time between countries

The total population of the validation studies from which the study sample was drawn are shown in Table 2, together with the total trained and untrained nursing time spent in direct patient care. The average time per individual was 84.4 min per patient per day in Japan, between 118.3 and 133.7 min in the USA, Sweden and Spain and 155.5 min per patient in England and Wales. Even when adjusted for case-mix, since the CMI did not differ greatly among the five countries, the same pattern persisted.

The difference in skill-mix is expressed as the percentage of total time represented by trained nurse time: 7.5% of nursing time was attributed to trained staff in the USA, between 14 and 18.2% in Japan, Sweden and Spain and 53.2% in the UK. The high ratio of nursing time attributed to trained staff in the UK persisted when rehabilitation wards were excluded: when long-stay wards alone were examined the proportion was 51.2%.

Staff time between RUG-III groups

Table 3 shows the staff time for the selected RUG-III groups in each country and the number of cases in each of the groups. Figure 1 displays these data graphically. The relationship between groups is very similar in all countries.

Different clinical characteristics, different physical dependency

When the physically more dependent (SSB, CC1 and PD1) and the physically less dependent (CA1 and PA1) were compared, with the exception of less time in CA1 than in PD1 in UK and Sweden, the time for the more severely ill groups was greater than for the less severely ill in all cases.

Table 2. Numbers of cases, Resource Utilization Groups represented and trained and untrained nursing time

<table>
<thead>
<tr>
<th></th>
<th>Japan</th>
<th>Sweden</th>
<th>England and Wales</th>
<th>Spain</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total no. of cases</td>
<td>873</td>
<td>405</td>
<td>1120</td>
<td>822</td>
<td>7648</td>
</tr>
<tr>
<td>Mean (and SD) nursing time per case (min)</td>
<td>84.4 (49.6)</td>
<td>133.7 (78.9)</td>
<td>155.5 (85.8)</td>
<td>127.3 (78.3)</td>
<td>118.3 (68.5)</td>
</tr>
<tr>
<td>Mean case-mix index</td>
<td>1.03</td>
<td>0.99</td>
<td>1.00</td>
<td>0.95</td>
<td>0.95</td>
</tr>
<tr>
<td>Case-mix-adjusted nursing time per case</td>
<td>73.3</td>
<td>126.5</td>
<td>155.5</td>
<td>127.2</td>
<td>115.9</td>
</tr>
<tr>
<td>Skill-mix b</td>
<td>14.0</td>
<td>18.2</td>
<td>53.2</td>
<td>16.4</td>
<td>7.5</td>
</tr>
</tbody>
</table>

a Mean nursing time per case/mean case-mix index.
b Trained nurse time as percentage of total nursing time.
Table 3. Mean nursing time in selected Resource Utilization Group (RUG-III) groups by country

<table>
<thead>
<tr>
<th>RUG-III group</th>
<th>Japan Mean (SD)</th>
<th>n</th>
<th>Sweden Mean (SD)</th>
<th>n</th>
<th>England and Wales Mean (SD)</th>
<th>n</th>
<th>Spain Mean (SD)</th>
<th>n</th>
<th>USA Mean (SD)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special care (SSB)</td>
<td>104.9 (49.1)</td>
<td>36</td>
<td>196.7 (96.6)</td>
<td>66</td>
<td>188.0 (68.3)</td>
<td>38</td>
<td>188.3 (42.3)</td>
<td>17</td>
<td>168.2 (58.3)</td>
<td>372</td>
</tr>
<tr>
<td>Clinically complex (CC1)</td>
<td>97.8 (46.4)</td>
<td>66</td>
<td>112.3 (52.3)</td>
<td>21</td>
<td>153.8 (76.7)</td>
<td>103</td>
<td>181.0 (59)</td>
<td>44</td>
<td>140.6 (55.9)</td>
<td>875</td>
</tr>
<tr>
<td>Reduced physical functions (PD1)</td>
<td>83.6 (29.3)</td>
<td>74</td>
<td>123.9 (51.5)</td>
<td>70</td>
<td>160.2 (78.3)</td>
<td>24</td>
<td>169.3 (57.5)</td>
<td>86</td>
<td>123.7 (53.8)</td>
<td>609</td>
</tr>
<tr>
<td>Clinically complex (CA1)</td>
<td>42.4 (29.1)</td>
<td>61</td>
<td>120.5 (78.9)</td>
<td>11</td>
<td>94.2 (66.1)</td>
<td>70</td>
<td>58.1 (30.0)</td>
<td>60</td>
<td>74.4 (51.3)</td>
<td>432</td>
</tr>
<tr>
<td>Impaired cognition (IA1)</td>
<td>49.0 (26.7)</td>
<td>56</td>
<td>104.7 (44.2)</td>
<td>21</td>
<td>128.6 (79.9)</td>
<td>16</td>
<td>86.6 (40.2)</td>
<td>38</td>
<td>58.4 (38.1)</td>
<td>310</td>
</tr>
<tr>
<td>Reduced physical functions (PA1)</td>
<td>42.8 (25.5)</td>
<td>112</td>
<td>73.8 (42.9)</td>
<td>15</td>
<td>77.1 (47.5)</td>
<td>55</td>
<td>47.4 (21.2)</td>
<td>82</td>
<td>44.7 (30.6)</td>
<td>884</td>
</tr>
</tbody>
</table>

**Similar clinical characteristics but different physical dependency**

When groups CC1 and CA1 and PD1 and PA1 were compared, with the exception of less time in CC1 than in CA1 in Sweden, time with the more physically dependent was greater than with the less dependent within the same clinical group in all countries.

**Similar physical function but different cognitive function**

In all countries time with the more cognitively impaired group (IA1) was greater than with the less cognitively impaired group (PA1). Time with the cognitively impaired group appears greater than with those in CA1 in the non-US countries, with the exception of Sweden.

**Discussion**

Our results show large differences in total staff time and trained nurse time spent with individuals in institutional care in five different countries. We have shown that the RUG-III system appears to function consistently in these countries, identifying similar relative patterns of staff care time between the more ill and the more physically dependent individuals. The pattern is as one would expect if RUG-III was consistently identifying the more ill and the more dependent and that time spent with patients reflected this whatever the total staff time available.

Of note is the high total time and high skill-mix in the UK sample. This is almost certainly due to the fact that these data were from purely hospital-based populations, where there is traditionally a close relationship with the staffing levels on more acute
wards. However even the pure long-stay wards in the UK had much higher skill-mix than the nursing home populations (51.2% qualified nurse time compared with 7.5–18.2%).

The differences suggested in this paper beg the question: what effect do the differences in skill-mix and actual time have on the care of these people? Comparisons of some aspects of quality of care between settings in different countries is addressed elsewhere in this issue [12–14].

Also of note was the difference between the USA (and Sweden but here the sample size was very small—11 cases in CA1) and non-US samples in mean time spent with cognitively impaired people. There has been considerable debate within the USA involving pressure groups such as the Alzheimer's Association focusing attention on the quality of care of patients with dementia. Staff time with individuals in special care units for patients with Alzheimer's disease in the USA was found to be lower than that for similar residents in nursing homes without special care units [15]. This was in spite of total time available being greater in the special care units, which had been selected as being examples of units with high quality care. The nature of time required to care for people with cognitive impairment may be qualitatively different, for example in supervision rather than direct patient care. Mehr et al. discuss the complexity of the relationships between staff time (and thus cost) and quality of care in these units which has a bearing on funding for people cared for in elderly mentally infirm nursing homes in the UK [15].

Conclusion

The data presented in this paper must be treated with caution given the small sample sizes in the European and Japanese datasets. However, the robustness of the RUG-III system cross-nationally is illustrated by the similarity of pattern of staff time between patient groups in addition to the good variance explanation demonstrated by RUG-III in each of the validation studies. This in spite of the wide range of health care settings with large difference in availability of nursing staff time and a wide range of skill-mix. Areas for further research are clearly indicated. The central issue is whether the greater amount of absolute nursing time and/or the greater ratio provided by qualified nurses lead to better outcomes and whether it could be regarded as cost effective compared with other forms of care.

Acknowledgements

E.C. acknowledges support from: Ministerio de Sanidad, Fondo de Investigaciones Sanitarias, project 93/0919; Fundacion Caja de Madrid, project 299.

References